Managing Food Waste in New York City

A Development Framework for Organic Waste Facilities

Who We Are:

This report represents the cumulative work of a 12-person graduate student consulting team in the Master of Public Administration in Environmental Science and Policy Program at the Columbia University School of International and Public Affairs.

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Client:

This report was commissioned by the Coalition for Resource Recovery, a project of Global Green USA. The Coalition for Resource Recovery is dedicated to reducing the waste stream in NYC and other municipalities, and it is a champion of practical solutions to global warming. Our team was tasked with developing a framework for how project developers for organic waste processing technologies can best work with community groups in order to site new organic waste processing facilities, as well as to evaluate New York City and New York State permitting requirements to identify the jurisdictive obstacles to siting new organic waste infrastructure and the successful deployment of food waste recovery systems.

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Acknowledgements:

The following report and past four months of research would not have been possible without the expert advice and consultation of our client and Global Green project liaison, Matt de la Houssaye, and our SIPA faculty advisor, Ms. Gail Suchman, Esq.

We also extend our warmest thanks to Kendall Christiansen, Morton Orentlicher, Fernando Berton, and Marvin Thomas for the time and assistance they each lent to this work.

Executive Summary

As the largest and most densely populated city in the United States, New York City (NYC) faces significant daily resource distribution challenges. The difficulty inherent in the physical transportation of goods in and out of the city is compounded by spatial limitations and the logistical complications in traversing the rivers and waterways separating four of the five boroughs from the mainland. While a global network coordinates the infrastructure required to bring goods into New York City, far less attention is given to the outflow and disposal of the city's waste.

Currently, 47,000 tons of waste are exported every day from NYC, nearly all of which travels to other states to be landfilled or incinerated. Approximately 1,640 tons of this waste is commercial food waste that can be separated out of, and removed from, the overall waste stream. Although seemingly a small amount of the total, food waste is wet, heavy and putrescible.

Landfilling represents a failure to utilize the resources in food waste most efficiently; and it takes up space, decreasing the landfills' long-term capacity. Moreover, this contributes to climate change through the release of greenhouse gases (GHGs) such as carbon dioxide and methane. These are the problems on which our client, Global Green USA's Coalition for Resource Recovery (CoRR), has focused in order to develop a feasible and effective program for managing food waste. CoRR's vision stems from its belief that "the waste from one activity is food for another, benefitting the economy, people, and the environment" (CORR, 2012). It seeks to redirect the waste discussion towards reducing resource loss, lowering energy consumption, and mitigating GHG emissions.

Our project team was tasked with identifying the process for siting and permitting and creating a community engagement framework for developers seeking to establish commercial food waste processing facilities in New York City. To that end, we identified the primary areas for consideration as: Technology, Siting and Zoning, Environmental Review and Permitting, and Community Engagement.

Based on those technical and regulatory considerations, **we developed a comprehensive framework detailing the road map for development**: selecting a waste processing technology, siting the project location, performing an environmental review (Environmental Impact Statement), and navigating the complex approval process for New York City and State operating permits.

We evaluated the various available technologies in terms of their emissions, cost, space requirements, feasibility, and potential community response. We identified key community concerns, including: truck traffic, pedestrian safety, and economic and environmental impacts. **Our research confirmed that anaerobic digestion (AD) is the most feasible technology for large-scale food waste processing in NYC**, which aligned with CoRR's goals for our project.

The purpose of this report is to provide stakeholders at all levels with the guidelines and best-practices necessary to assist them in developing food waste treatment centers, while also addressing environmental concerns and long-term sustainability goals commensurate with managing food waste in NYC. **Any successful project development plan will rely heavily on community participation and cooperation**, and the lessons learned from past endeavors will bear guidance for any future ventures.

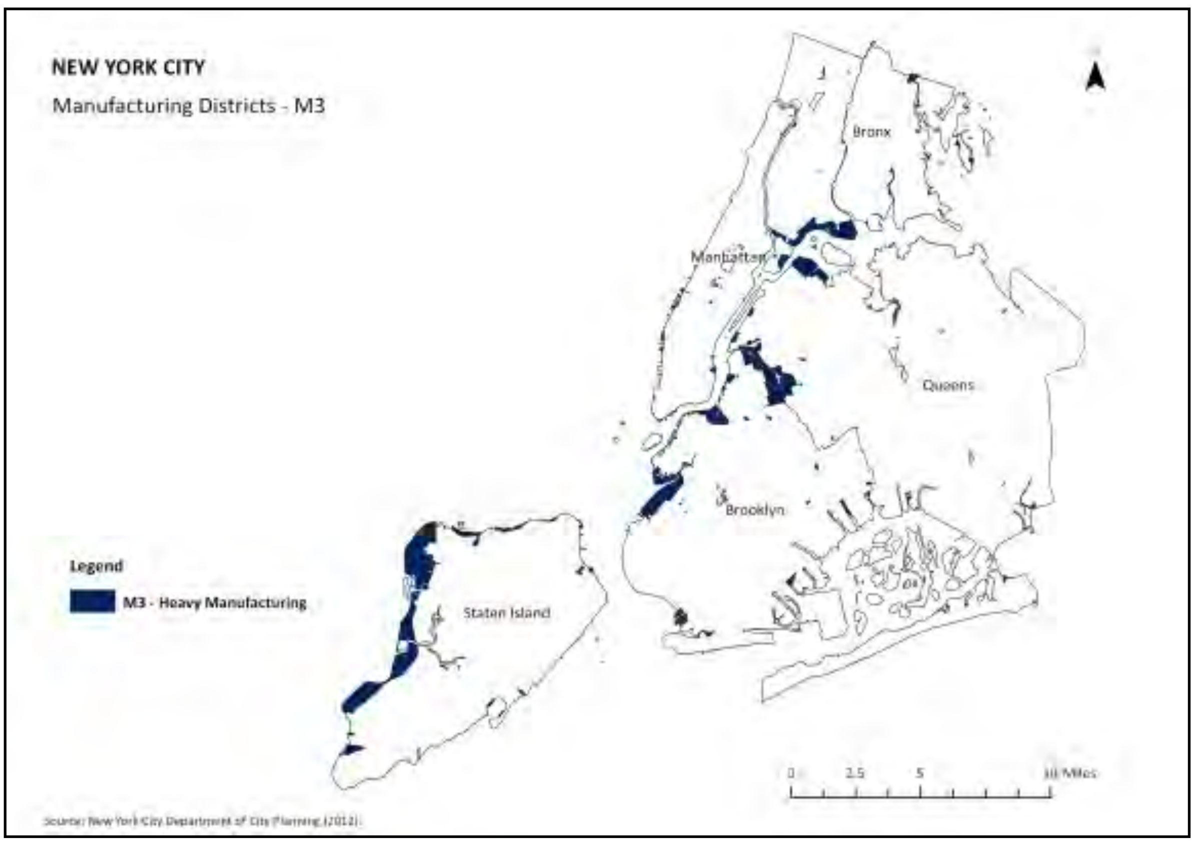
Concepts of "borough equity" and "community collaboration" have become key principles of waste policy and are enumerated in the City's PlaNYC 2030 and the Solid Waste Management Plan of 2006 (DSNY, 2008). We use these principles in our analysis of city and state regulations. Generally, the placement of facilities is limited by distance to residential areas, permissibility for the facility within a borough, and the number of facilities already in existence within the community district.

One important finding is that **there are currently no city or state regulations covering anaerobic digestion facilities for food waste,** and clarification must be sought from city and state agencies. We interpreted rules for similar types of facilities in our analysis. We determined that due to existing zoning regulations, an anaerobic digester can only be located in a M3 zone. **The limited availability of M3 zones in the city represents a challenge for development** (See Map 1).

In looking at the environmental review process, we have determined that **developers should focus on the preparation of a comprehensive Environmental Impact Statement (EIS)**. This will allow a developer to identify the negative impacts of a proposed project on the surrounding environment, and to work with the community to establish suitable mitigation strategies. Potential environmental concerns include: noise, odor, air emissions, fire and explosive hazards, water use, and effluent runoff. In addition, environmental justice and socio-economic impacts are of great import.

Any feasible development strategy will inevitably require significant, positive community support, as community resistance can slow and even kill project development. A community engagement plan will be required. This report provides a framework for garnering community support and devising community participation plans, even before the siting process formally begins. We have

Map 1: M3 Zones in NYC

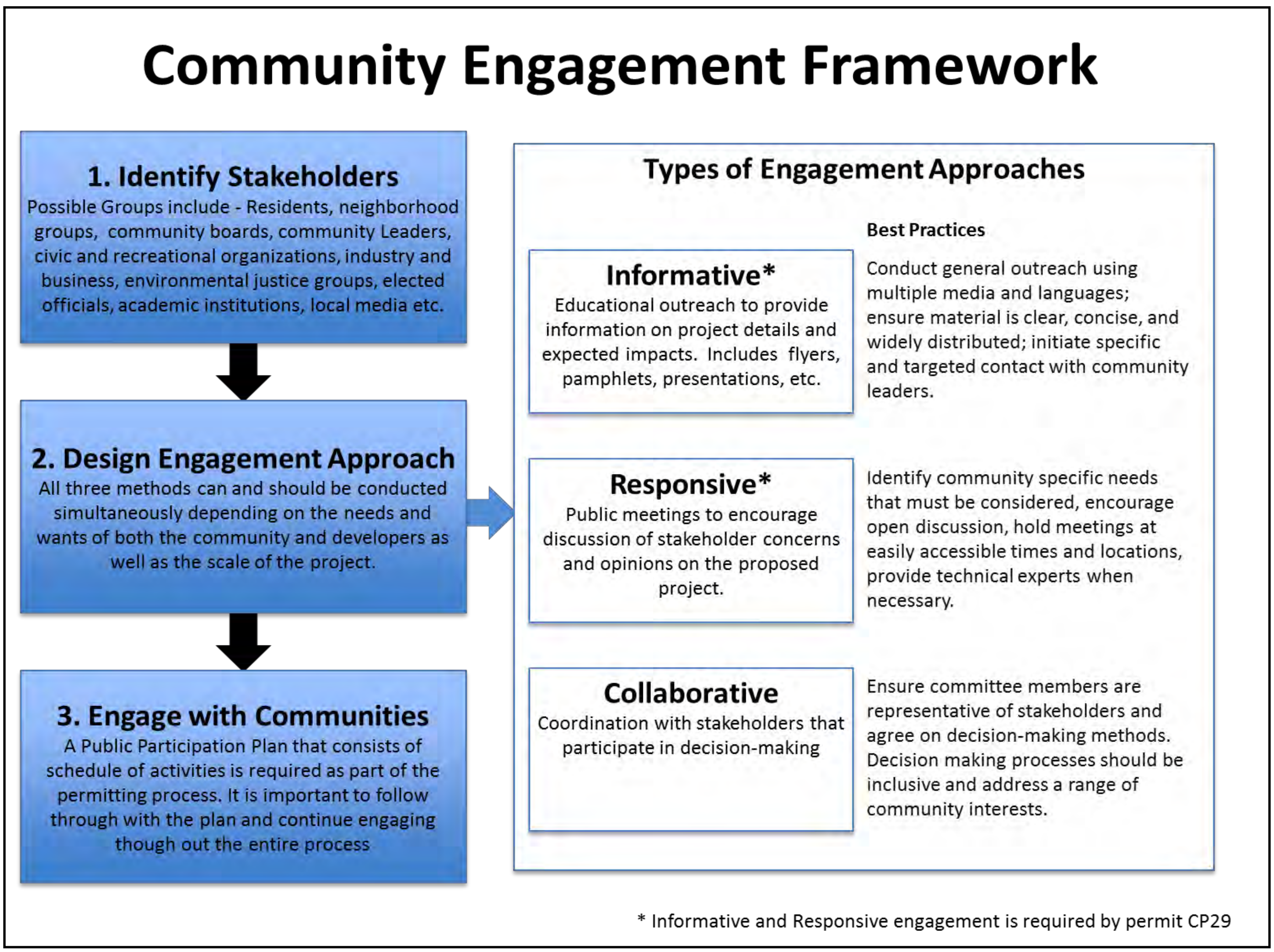


identified the key components for effective, long-term community engagement as: identifying stakeholders, creating an engagement plan, and undertaking continuous engagement.

With these recommendations, developers may envision a pragmatic roadmap for siting and operating a food waste processing plant in an urban area. This requires the due diligence of adhering to the permitting requirements, but, notably, also details the importance of a successful community outreach and engagement protocol.

The spatial, environmental and regulatory challenges unique to New York City provide further evidence that, if the roadmap proves effective here, similar projects may be developed in other areas of the country. It is our hope that this report may be used as a model to catalyze food waste management strategies in other cities in the United States.

Figure 1: Community Engagement Framework



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List of Acronyms

AD	Anaerobic Digestion
ARI	Alternative Resources, Inc.
BTU	British Thermal Unit
BWPRR	Bureau of Waste Prevention, Reuses and Recycling
CBA	Community Benefit Agreement
CBs	Community Boards
CEQR	City Environmental Quality Review
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CP-29	Commissioner Policy 29
DCP	Department of City Planning
DEC	Department of Environmental Conservation
DEP	Department of Environmental Protection
DOB	Department of Buildings
DSNY	The City of New York Department of Sanitation
EBMUD	East Bay Municipal Utility District
EDC	Economic Development Corporation
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Environmental Science Associates
GHG	Greenhouse Gas
H_2S	Hydrogen Sulfide
HCl	Hydrogen Chloride
M1	Manufacturing Zone 1
M2	Manufacturing Zone 2
M3	Manufacturing Zone 3
MSW	Municipal Solid Waste
NH_3	Ammonia
NOx	Nitrogen Oxides
NYC	New York City
NYCRR	New York Code, Rules and Regulations
NYS	New York State
O&M	Operations and Maintenance
OWS	Organic Waste Systems
PM	Particulate Matter
RFP	Request for Proposals
SCR	Selective Catalytic Reduction
SEQRA	State Environmental Quality Review Act
SO_2	Sulfur Dioxide
SWMP	Solid Waste Management Plan
TPY	Tons per Year
ULURP	Uniform Land Use Review Procedure
VOCs	Volatile Organic Compounds

Introduction

Purpose of the Report

Current solid waste disposal practices in New York City (NYC) rely primarily on distant landfills and traditional incinerators. However, increasing environmental concerns and rising petroleum costs have pushed NYC and other municipalities across the nation to re-evaluate the way they approach solid waste management. In NYC Mayor Bloomberg's PlaNYC 2030 commits to diverting 75% of the City's solid waste from landfills to reduce the negative environmental, economic, and community impacts associated with current City solid waste management practices (OLTPS, 2011). Recognizing this same need for change, the Coalition for Resource Recovery (CoRR), an initiative of Global Green USA dedicated to reducing the waste stream in NYC and other municipalities, has commissioned this report. Intended to complement work previously completed by the CoRR, the objective is to identify permitting and siting obstacles and create a community engagement framework that will serve to facilitate the siting of organic waste processing facilities in New York City.

The NYC Waste Problem

New York City generates 47,000 tons of waste every day. This waste stream is comprised of residential, municipal, commercial, and construction waste, most of which is exported via rail, boat and truck to states as close as New Jersey and as far away as Ohio for landfilling and incineration (Iman, et al, 2011) . Current solid waste management practices come at great financial and environmental cost, unnecessarily burdening the city and its businesses (OLTPS, 2011).

Within NYC, food waste comprises 18% of all residential solid waste and an estimated 11% of commercial solid waste, (when excluding construction and demolition fill). This represents a significant portion of the waste stream (OLTPS, 2011). However, conventional food waste disposal practices in the US are problematic. Food waste disposal unnecessarily uses limited landfill space in the US (Cohen, 2006), and its decomposition results in the uncontrolled release of greenhouse gases during transportation and in landfills (United States Environmental Protection Agency, 2012). Furthermore, food waste deposited in landfills represents a loss of nutrients to the environment. While composted food waste can be returned to the soil as fertilizer, which has a positive effect on soil structure, landfilled food waste and its nutrient by-products are trapped within plastic liners and comingled with potentially toxic contaminants commonly found in other types of municipal solid waste (United States Environmental Protection Agency, 2011).

A Development Framework

Three principal methods for processing food waste are aerobic digestion, anaerobic digestion and thermal processing. While there are many technologies available from a larger number of developers, none are currently processing food waste in densely populated areas. Thus two key challenges for project developers are (1) navigating the rigorous permitting and environmental assessment processes for a new technology, and (2) gaining community support for such a project. Based on feedback from environmental justice groups and our client, and considering the constrained space availability in NYC, anaerobic digestion is seen as the most feasible method for processing and it is the focus of this report.

Waste management is a particularly sensitive issue in NYC due to the long and contentious history of waste processing (landfills and incinerators) and the burden of these facilities on low income communities. As a result, any feasible development strategy requires considerable community support.

While this report, among other things, provides a framework for garnering community support and devising community participation plans, even before this process can begin, the issue of waste reduction must be addressed. Other studies have documented the importance of waste reduction and provide implementation strategies (such as the Environmental Protection Agency [EPA]) and as such, this aspect of the process will not be covered in great detail within our report. Also not covered within this report is the issue of food waste transportation. Source-separated food waste will likely require separate waste collection vehicles that are specially designed to haul this denser, wetter waste source without disseminating emissions in transit.

The framework presented in this report encompasses three key elements: siting and zoning, environmental review and permitting, and community engagement. We intend to address the interplay of all three elements in order to contextualize the issue of facility development in New York. This report builds upon past studies which have evaluated food waste processing technologies and their financial feasibility but which have failed to evaluate the target location of New York City. This report focuses on anaerobic digestion in NYC at the request of the client and given the feedback received from City environmental justice groups. However, we believe that many aspects of this report apply to a broader range of food waste processing technologies, and can thus be viewed as a methodology for food waste processing more generally.

PlaNYC Initiatives related to Solid Waste/Food Waste Management

NYC's long-term sustainability plan, PlaNYC, was launched in 2007 by Mayor Bloomberg as a means for preparing NYC and its associated civic infrastructure for the demands of future generations. As part of this initiative, PlaNYC is committed to reducing the City's waste stream, a significant component of which is food waste. One specific initiative within PlaNYC, addressing food waste, calls for additional opportunities to recover organic material (OLTPS, 2011). NYC hopes to create more opportunities for composting for both residential and commercial food waste. The City also hopes to pilot conversion technologies like thermal processing and anaerobic digestion, in order to reduce the volume of waste exported from the City and to ease the pressure on City's waste transportation network (OLTPS, 2011). Finally, PlaNYC taps the Hunts Point Food Distribution Center for the development of a food waste recovery facility. Hunts Point is the largest food distribution center in the US (OLTPS, 2011) and generates 27,400 tons per year of food waste. A facility developed at this site would likely be very similar to the ones our report aims to facilitate.

TECHNOLOGY

Introduction

Reviewing and identifying the most appropriate food waste processing technology for application in urban areas is a fundamental step in developing a long-term food waste management strategy for New York City (NYC). Understanding the positive and negative impacts of multiple food waste technologies will enable developers to better assess the necessary siting and permitting requirements, and, moreover, to construct a more transparent community engagement plan. To that end, this chapter will first survey past and present large-scale composting applications in NYC. Then, the applicability of three different food waste technologies – aerobic digestion (in-vessel and windrow), thermal processing, and anaerobic digestion – will be evaluated for project viability. Finally, air pollution control technologies that are required to treat pre- and post-biogas combustion will be examined.

I. Large-Scale Composting in NYC

For the past 20 years, NYC has proposed – and subsequently implemented – a variety of composting initiatives. However, a food waste composting facility for which source-separated organics from throughout the city can be processed has yet to be built. The collection and processing of all of NYC's organic waste, including food, yard trimmings, and leaves, poses significant challenges for site permitting and space distribution.

The first large-scale composting endeavor in NYC began as a pilot project in 1990, at the Edgemere Landfill in Queens. Now closed, this facility processed both residential and commercial yard trimmings, including Christmas trees (Flammer, 2005). That same year, the Department of Sanitation (DSNY), specifically the Bureau of Waste Prevention, Reuse and Recycling (BWPRR) began curbside collection of yard trimmings in Staten Island, Brooklyn, Queens, and the Bronx; this collection continues to this day on a weekend schedule and has become a more efficient collection program over the years (Flammer, 2005).

NYC currently operates two centralized, large -scale windrow composting (open-space/open-air environment) facilities for yard trimmings and leaves: one sited near the closed Fresh Kills Landfill in Staten Island, and the other in Soundview Park in the Bronx (DSNY, 2012). The Fresh Kills 24-acre site went into operation in 1990 (Flammer, 2005). Since its opening the facility has increased its processing volume and during 2004 accepted a total of 6,600 tons of yard waste from private landscapers and 11,800 tons of leaves from Staten Island, Brooklyn, and Queens (Flammer, 2005). According to the New York Times, the Department of Sanitation has expressed a desire to increase capacity by 33% at the Fresh Kills site, and by 45% at Soundview, though specific plans for these increases were not provided (Williams 2006).

Following the signing of a Memorandum of Understanding in 1997 by the DSNY and the New York City Department of Parks and Recreation, the BWPRR was authorized to open additional decentralized compost facilities on vacant, undesirable parklands in exchange for supplying the Parks Department with compost (New York City Department of Sanitation [DSNY], 2001). This agreement led to the opening and operation of a composting facility at Ferry Point Park in the Bronx, at Canarsie Park in Brooklyn, and at Idlewild in Queens (DSNY, 2001). However, all of these facilities have since been closed down; Ferry Point was closed in early 2000 to make room for the development of a golf course, followed by the closure of Idlewild and Canarsie Park in 2005, both as a result of neighborhood complaints regarding smell and the use of park space (Williams, 2006).

Prompted by the closure of Ferry Point Park, a new compost facility was constructed at Soundview Park in the South Bronx in 1999. The 7-acre site only receives leaves collected by the Department of Sanitation, processing approximately 6,000 tons per year of organic material (Flammer, 2005). Williams described that similar to the other now-closed facilities, citizens have voiced their concerns regarding the potential for odor and aesthetic issues with a composting processing facility in a public park, as well as the site placement in low-income neighborhoods (Williams, 2006).

While there are multiple small- and medium-scale, in-vessel composting efforts, (composting in a contained environment, often in a reactor), in operation today at schools, hospitals, and parks, New York's only large-scale composting facility for food waste is located on Riker's Island, home to one of the nation's largest municipal prison systems. Operation of the in-vessel composting facility began in 1996 and has traditionally composted approximately 80% of the island's annual food residuals, a processing amount that comes to approximately 4,500 tons annually (Flammer, 2005). This project has been successful due to the available space, as well as the efficient and low-cost collection of source separated waste possible on the island (DSNY, 2001).

Outdoor windrow composting projects require large areas of land for operations, often exceeding 10 acres. Robert Lange, director of BWPRR, has noted that one of the biggest challenges to urban composting is the significant amount of land required (Flammer, 2005). Furthermore, there are challenges associated with the source separation of food waste, particularly with regards to the residential and institutional sectors.[1]

As with any major development, community concerns are very influential in determining the success of solid waste management. The examples described above depict that, even when the city has found sufficient tracts of land, the facilities often face complaints from surrounding communities. Most previous composting centers have been located in low-income neighborhoods in the South Bronx and Brooklyn, leading to resentment with local residents. The main concerns of critics include the pungent odor, which has been present at these facilities in NYC in the past, and the fact that already limited park space is used for composting rather than recreation (Williams, 2006). Despite many New Yorkers' positive attitudes towards recycling, large scale composting endeavors have not always been supported in NYC.

II. Applicability of Food Waste Technologies in New York City

In this section, the applicability of aerobic digestion, thermal processing, and anaerobic digestion in NYC are evaluated based on their (1) scalability and physical footprint, (2) environmental impacts, and (3) financial feasibility. After a survey of the three different food waste technologies, analysis below reveals and explains why anaerobic digestion may be the most appropriate food waste technology for NYC.

A. Aerobic Digestion

Aerobic digestion refers to the breaking down of organic waste by microorganisms in the presence of oxygen. There are two main types of aerobic digestion: (1) windrow and (2) in-vessel. Windrow aerobic digestion is completed in outdoor spaces, where waste is spread into rows or piles during the digestion process. In-vessel aerobic digestion refers to contained, closed repositories within which the processing of waste occurs.

As illustrated in the previous section, composting placement is often rebuffed by various neighborhoods due to their concerns with odor and aesthetics. Moreover, according to Steve Last, windrow composting has a large physical footprint, requiring approximately 2.5 to 5 hectares (6.18 to 12.36 acres) per 50,000 tons per year (tpy) of waste (Last, n.d). The waste is piled into heaps measuring 2-3 meters high and 3-5 meters wide, and is spread up to 100 meters in length (Last, n.d.). Due to the amount of space required and the use of open-air methods to date of windrow aerobic digestion has been challenging to site in NYC.

Alternatively, in-vessel digestion has several comparative advantages to other composting technologies, particularly when assessing feasibility in a large city like NYC. The contained nature of this process allows for improved control and easier monitoring and operational management. In addition, less land area is required and weather has little effect on the process. Though more costly than windrow composting, in-vessel processing is a more feasible option for large amounts of organic waste in urban areas.

According to the US EPA, some potential areas of concern for local populations over in-vessel composting are fire and possible wastewater contamination risks. However, it is unlikely that in-vessel composting will

Figure 2: Windrow composting at Jepson Organics near

NYC Study on New and Emerging Solid Waste Management Technologies

NYC's Comprehensive Solid Waste Management Plan (SWMP) calls for the creation of a 20 -year solid waste management system that is cost-effective, reliable, and environmentally responsible (ARI, 2012). As a key part of the SWMP, the City has embarked on a 3-Phase study to identify and evaluate the implementation of new and emerging solid waste management technologies in NYC that are either already commercially deployed for MSW abroad or have recently become commercially operational nationally (NYCEDC and DSNY, 2004).

The Phase 1 Study, which was jointly prepared by the New York City Economic Development Corporation (NYCEDC) and the DSNY in September 2004, presented 43 technologies to be considered. They are categorized as thermal processing, aerobic and anaerobic digestion, hydrolysis, chemical processing, and mechanical processing for fiber recovery (ARI, 2006). Through the Phase 1 Study, the City determined that the technology categories of anaerobic digestion and thermal processing have developed the furthest; both technology types are currently in commercial operation for mixed MSW outside of the U.S. (ARI, 2006).

In the Phase 2 Study, which was prepared by Alternative Resources, Inc. (ARI) for the City of New York in 2006, (ARI, 2012), 14 of the 43 technologies from the Phase 1 Study were evaluated based on specific criteria, including size (at least 50,000 tpy capacity), reliability, environmental performance, beneficial use of waste, and residual waste (ARI, 2006). The technology types of the 14 technologies examined are anaerobic digestion, thermal processing, and hydrolysis technologies (ARI, 2006). The goal of the Phase 2 Study was to provide further evidence, including information provided by the technology vendors themselves and their reference facilities, that the AD, thermal processing, and hydrolysis can reasonably meet potential expectations for City application (ARI, 2006). The Phase 2 Study concluded that AD and thermal processing technologies could be successfully applied in NYC (ARI, 2012).

The goal of the Phase 3 Study, also prepared by ARI in 2012, was to perform a preliminary investigation and identify potential sites for a new and emerging technologies pilot facility (ARI, 2012). After screening sites based on developed siting criteria, nine potential sites located in Brooklyn, Manhattan, Staten Island, and Queens were identified for comparative evaluation. These sites were grouped into "Not Acceptable", "Acceptable", or "Advantageous or Highly Advantageous" categories. Five of the nine potential sites identified were categorized as "Acceptable," and two were considered "Advantageous or Highly Advantageous". The Phase 3 Study concluded that there are viable sites for demonstrating anaerobic digestion and thermal processing technologies (ARI, 2012).

negatively impact surface water bodies, since specific technologies can be designed to contain runoff (EPA, 2000). In addition, the composition of materials used for aerobic digestion is carefully selected because the technological process must consider the moisture content, volatile organic compounds (VOCs), carbon, nitrogen and expected density of the waste that will be input. For instance, some systems require a water input to add moisture, protect against fires and control temperatures (Mohee and Mudhoo, 2005; EPA, 2000).

While the amount of land required for in-vessel digestion varies by technology, the vertical, contained nature of these systems is more feasible for an urban location than other composting technologies. Larger scale projects (for example 200,000 tpy of waste) may require 5-6 hectares (12.36-14.83 acres) of land (Last, n.d.). In-vessel aerobic digestion is therefore a more favorable composting technology than windrow in terms of their physical footprint and environment impacts in an urban setting.

B. Thermal Processing

Thermal processing refers to technologies that utilize the application of directed, high temperatures in order to process waste. Although our research has found that thermal processing is not generally used to process food waste alone, but rather for a mixed waste source, thermal technologies still can be considered to process food waste. Food waste is wet, making it difficult to use as a single feedstock for thermal processing. Some examples thermal processing are high-temperature gasification, plasma arc gasification, flash pyrolysis (also known as thermal cracking) and depolymerization. Through these processes organic waste is converted to energy in the form of gas. The typical synthesis gas produced is known as "syngas," a combination of hydrogen, carbon monoxide and carbon dioxide. Some technologies produce fuel gas rather than syngas, while others augment the produced syngas with supplemental fuel to improve quality and consistency (Alternative Resources, Inc. [ARI], 2006). The gas produced can be used on-site, stored and sold, or

NYC's RFP for Waste-to-Energy Pilot Facility

On March 6, 2012, Mayor Bloomberg announced the release of a Request for Proposals (RFP) to commission a pilot waste-to-energy facility. The RFP sought proposals to convert waste to clean energy as part of PlaNYC's sustainability mission (Office of the Mayor, 2012). The decision was based on the findings of the 3-Phase SWMP studies (DSNY, "New and Emerging Conversion Technology"). DSNY is currently requesting proposals from private vendors and developers to permit, design, construct and operate a conversion technology facility to accept up to 10% of the City's waste (DSNY, "New and Emerging Conversion Technology"). The approved proposal will be entirely responsible for construction costs and distribution decisions related to the clean energy produced by the facility (DSNY, "New and Emerging Conversion Technology"). This RFP for new and emerging solid waste management technology, which includes anaerobic digestion and thermal processing, is due on June 5, 2012 (Office of the Mayor, 2012).

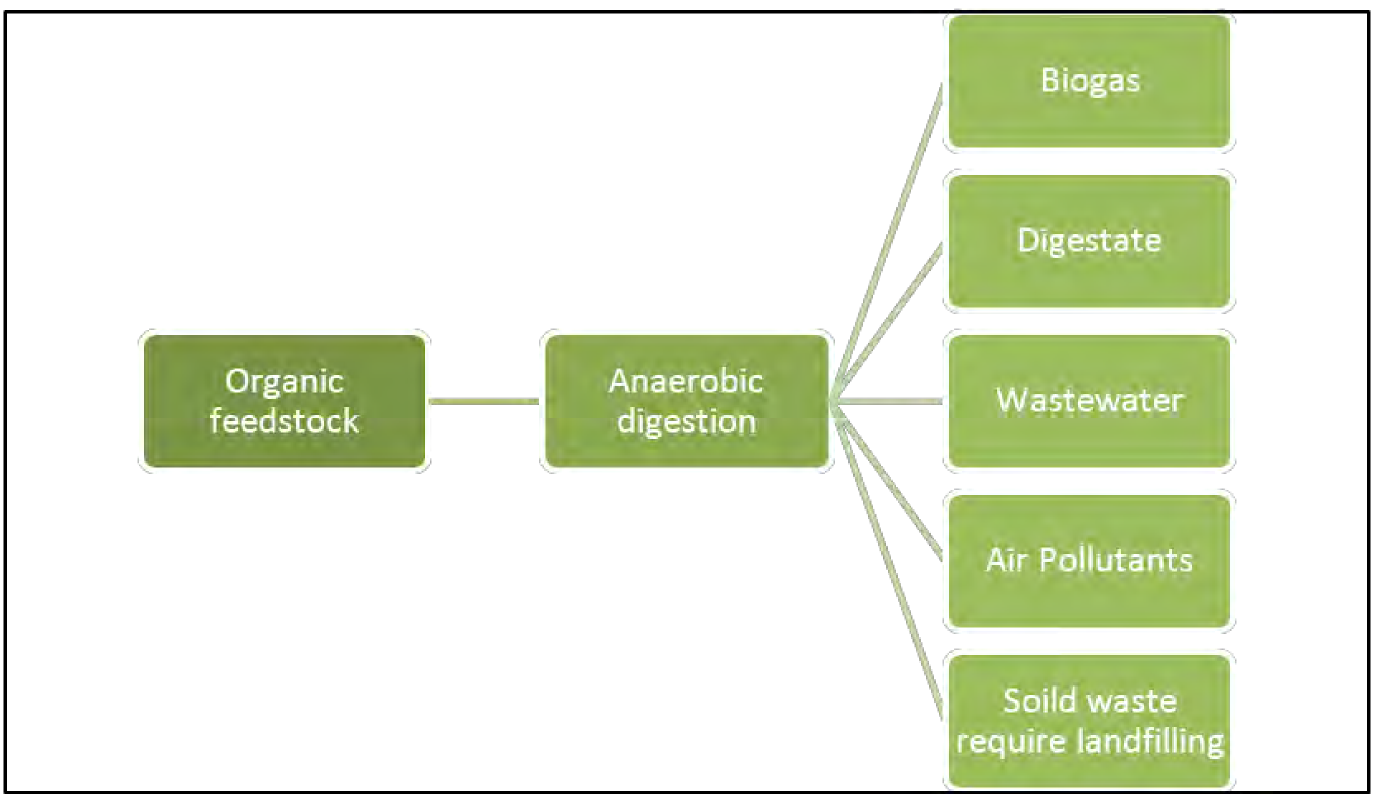
processed into other chemicals.

Many community and environmental groups in NYC have an aversion to thermal processing technologies, and assert that there is little difference in the impacts between traditional incineration and these newer technologies. In response to a recent city proposal to create pilot waste-to-energy projects, many environmental and community groups joined together to oppose thermal technologies from being approved for these projects. Their open letter cites potential toxic pollution, lack of data and proven success of commercial-scale gasification projects, alleged flaws in the proposed technologies, as well as public health and air quality impacts as objects of protest (Bautista, 2012). Many of the organizations signing on to the letter also issued statements on their websites; the Newtown Creek Alliance, for example, called thermal conversion technologies the "cousin of incineration," a technology widely known to have negative public health and environmental impacts (Newtown Creek Alliance, 2012).

C. Anaerobic Digestion

Anaerobic digestion (AD) refers to the breaking-down of organic waste by microorganisms in an environment without oxygen, and is the principal decomposition process that occurs in landfills (Rapport et al., 2008). In the past few decades there have been multiple successful anaerobic digestion applications worldwide, including the treatment of sludge, source separated food waste, industrial wastewater, animal waste, and mixed municipal solid waste (MSW). These applications have been used to decrease biodegradable content in waste, and thereby total waste volume, as well as to produce energy. The feasibility of applying anaerobic digestion to large-scale treatment of food waste or the organic fraction of mixed solid waste has also been successfully implemented

Figure 3: General influents and effluents of anaerobic digestion systems



in numerous instances (Rapport et al., 2008).

Below is a schematic that depicts the general influents and effluents of anaerobic digesters: There are two main categories of anaerobic digestion technologies: (1) wet anaerobic digestion and (2) dry anaerobic digestion. Despite slight differences between their input requirements and processes, wet and dry anaerobic digestion yield similar end products and environmental footprints. Depending on their design, both wet and dry anaerobic digestion processes can be carried out in a one-stage or two-stage system.

Figure 4: Food Scraps are loaded into an anaerobic digester in Atwater, California (Kqedquest, 2007)

Dry Anaerobic Digestion

In a dry anaerobic digestion system, pre-separated organic waste is placed in a reactor set at temperatures both in the mesophilic range – between 25–40°C – or the thermophilic range, which is 45 °C and above. The decomposition process takes approximately 15 to 21 days to complete; the retention duration varies based on technology deployed (ARI, 2006). The useful byproducts of this process include biogas, which can be combusted to generate electricity, and digestate, which is immature compost, the nutrient content of which can be used after dewatering and other post-treatment processes (ARI, 2006). Other effluents include wastewater generated from existing water content in the organic waste, solid residues that require landfilling, and air pollutants that are constituents of the biogas, notably hydrogen sulfide (H_2S) and ammonia (NH_3) (ARI, 2006 and Angelidaki et al., 2003. The issue of air pollutants will be discussed in the section entitled, “Environmental Impacts” below.

A dry anaerobic digester is capable of processing organic waste with a solids content of up to 35% of the total waste volume. Two widely applied and commercially available dry anaerobic digestion processes are the DRANCO and the VALORGA processes. According to its developer, the DRANCO process is a dry process that requires no water inputs to treat organic waste (Angelidaki et al., 2003), though fresh water is sometimes required to optimize biological activity in the digester (ARI, 2006). Alternatively, the VALORGA process is a semi-dry process, in which some water input is required. However, in this process the organic waste can be mixed with recycled process water from the digestion system itself, instead of fresh water (Angelidaki et al., 2003).

Wet Anaerobic Digestion

A wet anaerobic digestion system functions similarly to the dry anaerobic digestion process. The key difference between the two is the percentage of solids content a wet anaerobic digester can process. Wet anaerobic digesters, while capable of treating waste with high solids content, must be have water added so that the total solids content of the organic feedstock is below 20%, in order to create slurry that can be pumped through the wet anaerobic digestion system (Angelidaki et al. 2003). A wet anaerobic digester therefore can require significant water input in the organic feedstock than that of the dry process. The slurry can be created by adding fresh water or recycled process water (Angelidaki et al., 2003). To satisfy this additional water input requirement and minimize the usage of fresh water, an alternative process known as "co-digestion" can be used, where different types of waste, such as household, agriculture, and industrial are all processed in the same wet digester. In a co-digestion system, manure or sewage sludge can be mixed in to produce a pumpable slurry. Several biogas plants in Denmark have successfully adapted co-digestion systems that mix their waste stream with manure (Angelidaki et al. 2003).

One-stage vs. Two-stage systems

In addition to the differentiation between a dry or wet process for anaerobic digestion, the actual digestion can be carried out in either one- or two-stages. Developing a two-stage system instead of just one for both wet and dry anaerobic digesters relates to concerns with pH. As anaerobic digestion is a biological process that relies on microbial activity, maintaining a pH level suitable for those microorganisms is essential. The anaerobic digestion process is limited to a pH interval of approximately 6.0 to 8.5 (Angelidaki et al., 2003). During the first phases of decomposition, hydrolysis, a process that separates water molecules into hydrogen cations, the pH level in the digester is drastically reduced. This makes the digester uninhabitable to methanogens – methane-producing microorganisms – as they can only grow in a pH environment of around 7 (Angelidaki et al., 2003). Methanogens can thrive without oxygen while producing one of the two main constituents of biogas. Ensuring the presence of methanogens during the anaerobic digestion is therefore especially important as they provide the production, composition and quality of the biogas. Two-stage systems are thus designed to separate the hydrolysis and methanogenesis processes. The organic feedstock (source-separated waste), which does not require dewatering, is first deposited in the acidification or hydrolysis reactor (Angelidaki et al., 2003). Depending on the particular process deployed in the two-stage system, processed organic feedstock is then either dewatered prior to being deposited into a different reactor for the methanogenesis process, or is placed in the second reactor along with organic acids produced from the first reactor and diluted into the second reactor at a controlled rate (Angelidaki et al., 2003 and Rapport et al., 2008). In contrast, one-stage systems rely on the application of buffering salts like sodium hydroxide, to control pH and foster methanogen development (Garcia-Peña et al., 2011).

Scalability and Physical Footprint

With a better understanding of the anaerobic digestion processes, one can assess their applicability in urban areas like NYC. This is a particularly significant factor to consider for NYC, where space is very limited. Among commercial anaerobic digestion technologies deployed for MSW treatment around the world, different plants' annual capacities range from treating 3,000 to 270,000 tons of MSW per year (Rapport et al., 2008). This illustrates the high degree of scalability anaerobic digestion can provide as a technology for addressing food waste.

As its scalability suggests, anaerobic digestion also requires less operating space than composting. Table 1 displays the land area required for processing a certain tonnage of waste per year for specific anaerobic digestion technologies, as provided by different vendors. The acreage listed in the table indicates the total land area required to site a complete facility, which includes the digester itself and any other buildings necessary. The 20-acre site requirement made by Organic Waste Systems (OWS) includes all required facility components, in addition to a 4-month outdoor storage area for compost (ARI, 2006). The land area required for the DRANCO technology that OWS deploys would naturally be smaller if open-air compost was excluded.

Environmental Impacts

The environmental footprint of anaerobic digestion technologies is assessed by examining their influents and effluents, respectively. This section analyzes the environmental effects associated with anaerobic digestion, in particular total water usage and air pollution.

As discussed in previous sections, the only essential input required for anaerobic digestion is pre-separated organic feedstock. Another important input is water, especially for wet anaerobic digesters. However, fresh water isn't always required; biogas plants in Europe have developed ways to substitute water with recycled process water from the plants, sewage sludge, or even manure. Anaerobic digestion technologies can therefore have a small water footprint (ARI, 2006). In terms of disposing of wastewater generated from the process, most technologies have been designed to recycle processed water and to reuse water for waste mixing and waste separation (ARI, 2006). In this scenario, the amount of wastewater disposed to the sewage system is determined to be minimal (ARI,

Table 1: Physical Footprint of Wet and Dry Anaerobic Digestion (ARI, 2006). While the information displayed below comes from a study on mixed waste, it is nevertheless instructive in demonstrating the scalability of anaerobic digestion.

Process	Annual Capacity	Land Area Required
Wet Anaerobic Digestion (ArrowBio)	90,000 tpy of MSW	4 acres
Wet Anaerobic Digestion (ArrowBio)	225,000 tpy of MSW	8 acres
Dry Anaerobic Digestion (Waste Recovery Systems, Inc.)	182,500 tpy of MSW	14 acres
Dry Anaerobic Digestion (Waste Recovery Systems, Inc.)	1,095,000 tpy of MSW	60 acres
Dry Anaerobic Digestion (OWS)	182,500 tpy of source-separated organic waste	20 acres

2006).

With regards to air pollution contributions, anaerobic digestion's largest concerns are odor emissions and air pollutants generated during the combustion of biogas (Arsova, 2010). While there are some compounds that can be found in AD-produced biogas prior to its combustion, such as H_2S and ammonia, the combustion of biogas generates additional pollutants (R.W. Beck, Inc., 2010). Air pollutants commonly found after combusting biogas include H_2S, NH_3, nitrogen oxides (NOx), hydrogen chloride (HCl), sulfur dioxide (SO_2), particulate matter (PM), and carbon monoxide (CO) (Angelidaki et al., 2003 and ARI, 2006). Biogas combustion in particular generates higher content of NO_x emissions than other technologies, due to the nitrogen-rich content in organic waste. Effective air pollution control technologies are available to minimize the atmospheric emissions resulting from anaerobic digestion technologies, and these will be further discussed in the following sections. In comparison to thermal processing, which generates a variety of pollutants, anaerobic digestion possesses contribute minimally to atmospheric damage.

Beyond the environmental impacts of anaerobic digestion, AD also creates beneficial byproducts, energy and compost. Minimal

Food Waste Management and Climate Change

The development and operation of food waste management technologies like anaerobic digestion can help combat climate change. Processing source-separated food waste is one way to reduce some of the GHG emissions by diverting organic waste out of landfills, decreasing the long-distance hauling of waste. Recycling this food waste into biogas can also create a source of renewable energy.

Currently, the vast majority of NYC's waste is incinerated, or hauled and landfilled out of state. Landfills are the second largest source of methane (CH_4) emissions in the U.S. (Bracmort et al., 2011). This is due to the decomposition of organic materials in landfills into methane (California Department of Resources Recycling and Recovery, 2012). While current landfill technologies can capture 75% of the methane emissions generated, the remaining 25% still escapes into the atmosphere (USEPA, 1995). Another source of landfill GHG emissions come from transporting waste with fossil fuel powered vehicles (USEPA, Documentation for Greenhouse Gas Emission, 2012). Therefore, decreasing the amount of organic waste going into landfills is paramount to mitigating GHG emissions from landfills. Reduced landfill waste would lead to less activity at landfills, including a potential decrease in the vehicle miles travelled for fossil fuel combusting long-haul trucks (Environmental Science Associates [ESA], 2011).

In addition to diverting organics out of landfills and thereby reducing landfill GHG emissions, processing organic waste through anaerobic digestion can also decrease GHG emission through biogas production. The biogas generated can either be purified and transformed into vehicle fuels, or can be combusted to produce electricity for on-site use and/or potential sale back to the local electricity grid, thus reducing the usage of fossil fuel power (ESA, 2011). Multiple studies have quantified the reductions in GHG emissions through the diversion of organics into anaerobic digestion facilities (ESA, 2011).

water usage, less required landfill space, and the availability of air pollution control technologies, make anaerobic digestion an appealing food waste technology for NYC, and other areas where resources like water or space are limited.

Financial Feasibility

In addition to anaerobic digestion's technical viability, lower space requirement, and environmental benefits, the technology's financial feasibility must be assessed before determining its applicability for NYC. In this section, factors influencing the financial feasibility of different anaerobic digestion technologies are discussed, including potential revenue sources and costs. It is important to note, though, that the information presented below does not represent an exhausted review, but rather provides a point of reference for readers.

Sources of revenue for anaerobic digestion facilities include the tipping fees received, the sale of electricity from biogas combustion, and secondary products such as compost. Local regulations will determine whether carbon offset credits are a potential revenue source.

Regarding costs, based on a 2010 feasibility study conducted for the NYC Hunts Point Food Distribution Center, the initial capital costs for an anaerobic digestion facility processing 60,000 tons of food waste per year can range from $20-$45 million. However, real cost information on developing anaerobic digestion facilities is limited, as are annual operating expenses, which are highly variable based of facility capacity and efficiency, among other things. Despite the lack of real cost information, several studies have conduced cost analyses demonstrating that operating costs would decrease and plateau as a function of higher annual capacity for facilities (Rapport et al., 2008). Lastly, part of the economic viability of AD facilities is based on the quality of the final products (e.g. compost), which help generate revenue for the facilities. Different markets have different regulations on the quality controls required to reintroduce output materials into the marketplace

Table 2: Effluents of Wet Anaerobic Digestion, Dry Anaerobic Digestion, and Composting (ARI, 2006). It should be noted, however, that while dioxin and mercury are listed below as gaseous byproducts of anaerobic digestion, these emissions are of most concern when processing mixed municipal solid waste and are rarely produced in significant quantities when the waste source is source separated organics.

	Gaseous	Liquid	Solid
Wet Anaerobic Digestion	NOx, HCl, SO_2, H_2S, PM, CO, NH_3, dioxin, and mercury.	Wastewater	Digestate
Dry Anaerobic Digestion	NOx, HCl, SO_2, H_2S, PM, CO, NH_3, dioxin, and mercury.	Wastewater	Digestate
Composting	Bioaerosols, odors, water vapor and CO_2, volatile organic compounds (VOCs), reactive organic gases, PM, and NH_3.	Wastewater and Leachate	Compost

(Arsova, 2010).

While cost information for anaerobic digestion remains insufficient, several studies have pointed out that the financial viability of any anaerobic digestion project depends greatly on the tipping fees received, a key revenue source for anaerobic digestion projects (Rapport et al., 2008 and New York City Economic Development Corporation, 2010). Besides tipping fees, it is highlighted in the Hunts Point Feasibility Study that anaerobic digestion facility financial viability may depend on the sale (or on-site consumption) of the electricity generated from biogas combustion.

III. Air Emissions Control

Most air emissions associated with anaerobic digestion are generated during the combustion of the biogas after digestion. It is important, therefore, to optimize the viability of anaerobic digestion by mitigating the air pollutants they generate. In this section, we will explore the technologies available for both pre-combustion biogas purification and post-combustion air pollution control technologies.

A. Pre-Biogas Combustion Air Emissions Control: Biogas Purification

One of the most appealing features of anaerobic digestion is the subsequent energy produced through biogas combustion. This amount of energy generated depends on the purity and quantity of methane (CH_4) in the biogas.

As highlighted by a study completed by the East Bay Municipal Utility District in 2008, CH_4 and carbon dioxide (CO_2) are the primary gaseous products produced by the anaerobic digestion of food waste (R. W. Beck, Inc., 2010). Regardless of the exact composition of the food waste, AD biogas is also assumed to contain contaminants such as ammonia (NH_3), hydrogen sulfide (H_2S), carbon monoxide (CO), and other malodorous sulfurous compounds (Abatzoglou and Biovin, 2009 and U.S. Department of Energy). According to Orellana the removal of these contaminants from biogas is crucial for optimizing energy generation, ensuring the longevity of biogas engines and post-combustion control technologies like catalysts, as well as for meeting national and local air quality standards (Orellana, 2012).

To remove contaminants such as H_2S from biogas, and address odors, two main processes are commonly used: physicochemical processes and biological processes (Abatzoglou and Biovin, 2009 and Arsova, 2010).[2]

Physicochemical processes

Physiochemical processes are conventional, widely used methods for treating biogas. While physiochemical processes are well developed and widely deployed, there are financial and environmental disadvantages associated with the processes. As physiochemical methods utilize chemical reactions to remove certain compounds from the gas stream, they require the usage of various chemicals. Furthermore, these chemical processes also necessitate certain environmental controls to optimize the processes; for instance, the removal of H_2S involves high pressures and high temperatures (Mahmood et al., 2006). Physiochemical processes can therefore be environmentally and financially costly. There are three types of commonly used physiochemical processes to remove H_2S: chemical absorption in aqueous solution or solid adsorbents, and scrubbing, and they are described in Appendix 1 in greater detail.

Figure 5: A biogas purification plant in Lund, Sweden (Duvander, 2010).

Biological processes

An alternative to physiochemical processes, biochemical processes have gained popularity in recent years due to their low costs and environmental benefits (Kennes et al., 2009). Biofilters, biotrickling filters, and bioscrubbers are the three most common biological processes used for waste gas treatment today (Kennes et al., 2009). Conventional physiochemical methods for removing H_2S are costly due to their energy use and chemical inputs in order to operate efficiently (Mahmood et al., 2006). Conversely, biological processes do not require the addition and utilization of chemicals, and as microbiological processes can proceed around ambient temperatures and at atmospheric pressure, energy costs are reduced to a minimum (Mahmood et al., 2006). The treatment of sulfide (S^{2-} from H_2S), for instance, is especially suitable for biological processes as it is one of the few bacterial degradation that happen with the presence of oxygen and at normal temperature (Mahmood et al., 2006).

Biological processes are generally more suitable for treating low- to medium-flow rates of gases and low pollutant concentrations in comparison to physiochemical processes, as higher pollutant concentrations can be inhibitory to microorganisms (Kennes et al., 2009). As such, there has been only limited success in dealing with high concentrations of H_2S (>1000 ppmv) using biofilters, biotrickling filters and bioscrubbers and few industrial processes have been fully developed for such application (Fortuny et al., 2007).

Nevertheless, recent developments at the laboratory-scale have demonstrated that biological processes can be suited to treat high concentrations and loads of pollutants (Kennes et al., 2009). For instance, one study developed a single biotrickling filter reactor that can effectively treat gas streams with H_2S concentrations up to 12,000 parts per million by volume (Fortuny et al., 2007). Moreover, fluidized-bed biofilter bioreactors have been shown to remove H_2S and NH_3, as well as co-treat VOCs (Mahmood et al., 2006). Recent developments have therefore shown that biological processes will likely soon be on par with conventional physiochemical processes. Many biological process technologies exist and are explored in greater detail in Appendix 1. Among the various biological processes explored for biogas purification, biofilters and biotrickling filters are the most extensively used bioreactors for air pollution control and are highly suitable for many full-scale applications.

B. Post-Biogas Combustion Air Emissions Control

While biogas cleaning prior to its combustion can help mitigate air pollution, post-combustion air pollution control technologies are necessary to reduce air emissions associated with biogas combustion. The two main air pollution control technologies used for biogas combustion are catalytic oxidation/ selective catalytic reduction and NOxTech, descriptions of which can be found in Appendix 1. Both technologies are effective, though NOxTech is less expensive.

Siting and Permitting

Introduction

A developer of food waste processing technologies in NYC will quickly come to understand that such infrastructure requires a significant amount of planning, political backing, community support, streamlining of pertinent legal and administrative codes, predevelopment capital, and, in all reality, a bit of luck to get through the overlapping processes in a reasonable amount of time. This chapter presents an overview of the multiple channels through which a project must proceed in terms of siting, zoning, environmental review, and permitting. While these processes are presented in a somewhat chronological sequence from start to project completion within the development cycle, it should be emphasized that many of these processes could be, and should be, implemented in parallel, in order to ensure timely completion of the development and construction of the project.

I. Siting

The Comprehensive Solid Waste Management Plan

With the closure of Fresh Kills Landfill in 2001, there are currently no solid waste disposal facilities in the City of New York (SWMP 2006). All waste is transferred to other municipalities and states through a network of land- and marine-based public and private transfer stations. Exporting waste from NYC results in high processing costs, an over-reliance on long-distance truck transportation and low levels of recycling. The siting of an anaerobic digestion facility to manage food waste in NYC could remove significant amounts of waste from the exported waste stream, resulting in the beneficial recovery of resources and a gas by-product that may be used to produce electricity. The City's 2006 Comprehensive Solid Waste Management Plan (SWMP) explicitly supports these overarching goals toward resource recovery. Overseen by The Department of Sanitation of New York (DSNY), the plan is an important milestone in NYC's waste management agenda. Moreover, any prospective developer of a solid waste management facility must demonstrate consistency with the plan as required by state regulations (6 NYCRR §360-1.9).

The SWMP offers a "long-term export program," as a "framework for dramatically reducing the number of truck trips and miles associated with disposal of NYC's waste… [and] establishes a cost-effective, reliable, and environmentally sound system for managing the City's waste over the next 20 years" (SWMP 2006, Appendix 1 for a map of current and proposed infrastructure). More importantly, the plan formulates key concepts of "borough equity" and "community collaboration", which stem from many years of community campaigning and advocacy on issues of environmental justice. The SWMP aims to treat each borough fairly and aims to include community input. The importance of these issues is further discussed in the following community engagement chapter. In response to these goals, the City has agreed to reconstruct four unused Marine Transfer Stations (MTSs) for long-term export by barge; this will "have the effect of creating significant new putrescible capacity for the City in areas that do not have large numbers of transfer stations," thereby reducing the burden on the most affected communities (SWMP 2006: 4-10).

What is a solid waste management facility?

Under New York State law a solid waste management facility is defined as "any facility employed beyond the initial solid waste collection process and managing solid waste," and includes (only the most relevant listed):

- storage areas or facilities
- transfer stations
- rail-haul or barge-haul facilities
- landfills
- disposal facilities
- solid waste incinerators
- refuse-derived fuel processing facilities
- composting facilities
- recyclables handling and recovery facilities

The term covers "all structures, appurtenances, and improvements on the land used for the management or disposal of solid waste." (6 NYCRR [New York Code, Rules and Regulations Chapter IV §360-1.2)

Siting Regulations in New York City and New York State Regarding Anaerobic Digestion

While the SWMP broadly discusses management of putrescible waste, it does not contain specific guidelines on siting an anaerobic digestion facility for food waste. Currently, it is uncertain whether the City will define such a facility as a compost facility, recycling facility, refuse-derived fuel facility, or some new classification that is not yet in the existing regulations. It is therefore important to look at the state regulations, as this will inform future NYC policy. New York State (NYS) has classified anaerobic digestion technologies as composting facilities under NYCRRR (6 NYCRR IV § 360-5.5) in the section "Organic Waste Processing Facilities For Biosolids, Mixed Solid Waste, Septage And Other Sludges". For the purpose of this paper, the assumption is made that AD is classified as compost in NYC, even though the City rules are still unclear. The regulations do not discuss source-separated food waste. A developer would need clarification from the State on the legal requirements applicable to source-separated organic waste *processing* facilities. In other words, there are no regulations governing the use of AD for treating food waste, only sewage sludge and farm wastes (manures); therefore the regulations must be expanded.

At the City level, the Rules of the City of New York (RCNY) do not address private solid waste management facilities except in the case of waste transfer stations, which must adhere to city-level regulations on air pollution and noise control that supersede the state requirements (RCNY Title 16 §4-12). This is because the City does not issue permits for any type of solid waste management except transfer stations. All other types of facilities are covered by state regulations, an important distinction for the siting process. However, a food waste AD facility in the City would likely have a level of impact on the surrounding area that is at least comparable to a putrescible waste transfer station in terms of noise, air emissions, and the number and associated type of transportation vehicles (RCNY Title 16 §4-13 and §4-14). However for the purposes of siting, the regulations for putrescible waste transfer stations can serve as a guide for how the city might regulate the technology because of their similar impacts. Additionally, RCNY regulations address the paramount "borough equity" issue discussed in the SWMP, and involve the regulations for the handling of putrescible waste. As food waste makes up a part of this total, the regulations may likely be clarified to include AD facilities. A developer should acknowledge the rules covering the siting of such facilities are described in below in order to ascertain where the pertinent components will come up for AD facilities.

The two main factors which should be considered in terms of siting are: (i) distance from residential areas; and (ii) number of existing facilities in the area. Generally, wherever a transfer station is located in NYC, the facility must be a minimum of 400 feet from a residential zone, hospital or public park (SWMP 4.4.2). The buffer distance increases based on the percentage of transfer stations already existing in the community district[3] – up to a maximum 16% of the total amount waste transfer stations – after which any increase in incoming waste must be accompanied by a 1:1 decrease in the same Community District (SWMP 4.4.4). At the 16% threshold, the buffer distance increases to 700 feet. Table 3 outlines the most affected community districts and the percentage of transfer stations in each area as of 2008.

In addition to these siting regulations, a developer must also be aware of and comply with all New York City Zoning Resolutions that further limits the locating of new infrastructure to specific industrial areas.

Figure 6: A Commercial Waste Transfer Station in Brooklyn, New York City. (Kreussling, 2007)

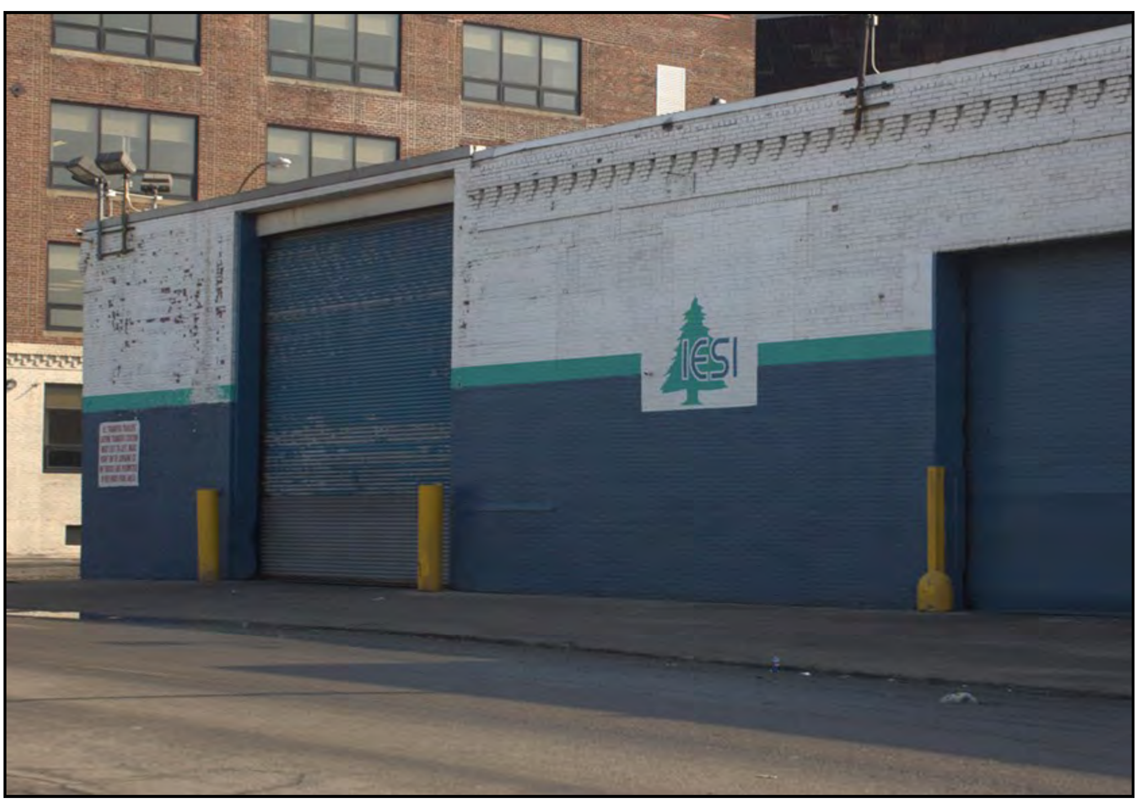


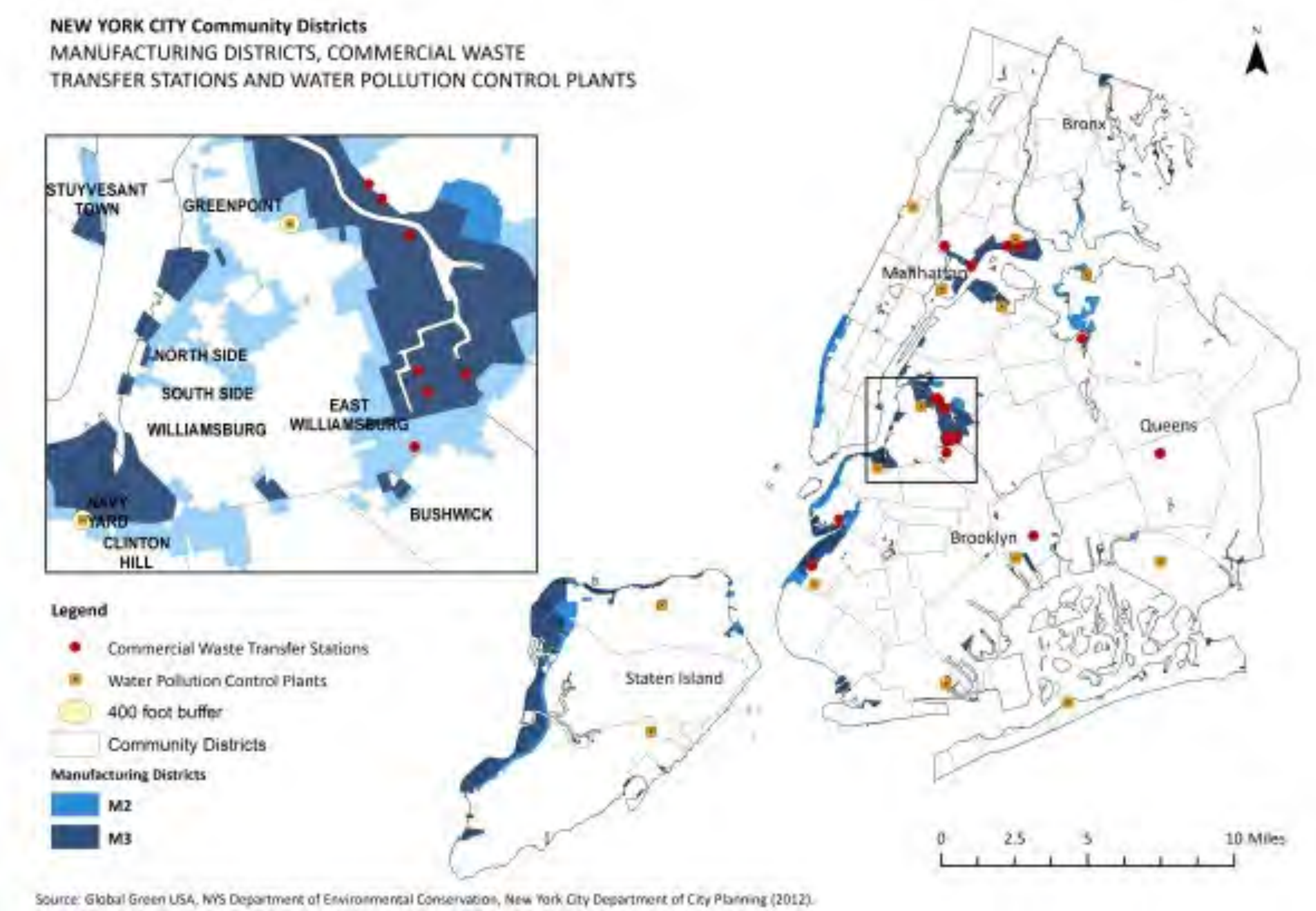
Table 3: Percentage of Existing Lawfully Operating Transfer Stations in New York City by Community (DSNY, 2008)

Percentage of Existing, Lawfully Operating Transfer Stations	Community Districts	Buffer Distance to Residential Districts, Hospitals, Public Parks & Schools	Buffer Distance between Transfer Stations	Additional Requirements	Zoning Requirements
16% or more	Brooklyn 1	700 feet	400 feet	(i)Facility enclosed; (ii) Truck queuing area on site; (iii) Offsets required	M2 and/or M3 districts only
From 12 to less than 16%	Bronx 2	600 feet	400 feet	(i)Facility enclosed; (ii) Truck queuing area on site; (iii) Offsets required	M2 and/or M3 districts only
From 8 to less than 12%	Bronx 1	600 feet	400 feet	Truck queuing area on site	M2 and/or M3 districts only
From 4 to less than 8%	Queens 2 Queens 5 Queens 7 Queens 12 Staten Island 2	500 feet	400 feet	Truck queuing area on site	M1, M2 and/or M3 allowed
Less than 4%	All other Community Districts	400 feet	400 feet	Truck queuing area on site	M1, M2 and/or M3 allowed

While the minimum distance cannot be lower than 400 feet in any area, in Bronx District 2 for example, which houses 12 – 16% of the facilities in New York, the buffer distance required is 600 feet between a facility and a residential zone, hospital or public park. To site a facility in any of the areas with an already high-percentage of existing facilities, a developer will have to demonstrate that the new facility will be able to offset and reduce the current volume of waste entering the existing facilities. See Map 2 for buffer zones around potential sites.

The map below displays the M2 and M3 industrial zoned regions throughout NYC, overlaid on a map of the city's community districts. Also shown on the map are the locations of commercial waste transfer stations, identified as red dots, and the locations of wastewater treatment plants, shown as orange dots. 400-foot buffer zones have also been mapped around the wastewater treatment plants to be used in assessing the feasibility of these locations for siting an anaerobic digester. 400 feet is the minimum buffer distance legally required between transfer stations (our proxy regulation for an AD facility) and a residential zone, hospital or public park.

Map 2: NYC M2 and M3 Industrial Zones and Commercial Waste Transfer Stations and Wastewater Treatment Plant Locations.



II. Zoning

A. Manufacturing Zones

Zoning regulations for all buildings and facilities in NYC are codified in the Zoning Resolution of New York (Zoning Resolution 2011, Article IV, Chapter 2). The city is divided up into residential, commercial, and manufacturing zones, each with different allowable uses and levels of environmental impact known as performance standards. Given the chemical processes and physical outputs of a large-scale anaerobic digester, it is very likely that such a facility would only be placed in a manufacturing zone. There are three types of manufacturing zones in NYC:

M1: Light industry that usually act as a buffer from M2 and M3 zones (i.e. woodworking, auto storage and repair, storage facilities)

M2: The middle ground between M1 and M3 zones, with more noise and vibration allowed than in M1, along with smoke. They are located along the river, mainly, and act as a buffer between M3 and M1 zones.

M3: Heavy industrial zones that generate noise, pollution and traffic. They are typically power plants, wastewater treatment plants, and putrescible waste transfer stations.

According to the Zoning Resolution (Article IV: Chapter 2), an M3 zone is the only zone that can contain flammable or gas combustion

Uses as a Matter of Right in M3 Zones
(Zoning Resolution, Article IV, Chapter 2, §42-15)

Use Group 18 consists primarily of industrial uses which:

(1) Either involve considerable danger of fire, explosion or other hazards to public health or safety, or cannot be designed without appreciable expense to conform to high performance standards with respect to the emission of objectionable influences; and

(2) Normally generate a great deal of traffic, both pedestrian and freight.

Manufacturing establishments:

- Incineration or reduction of garbage, offal or dead animals

Storage or miscellaneous uses, open or enclosed:

- Coal or gas storage
- Dumps, marine transfer stations for garbage or slag piles
- Electric power or steam generating plants
- Gas manufacturing plants

A Developer's Perspective

"A handful of states (CA, OH, MA) have or are updating siting/permitting/regulatory schemes to promote AD projects; several have been developed in Ohio by Quasar, but those are private projects that accept food scraps from various sources, not just from "cities." San Jose, CA, is developed high-solids AD project for organics coming from its new mixed-waste MRF, so will be interesting to see how that works in terms of both bio-gas production and use of residual products. Flint (MI) brought in Swedish Biogas to up-grade/operate its wastewater digesters, and now is searching for additional sources of organics."

- Kendall Christiansen, Principal of Gaia Strategies, Senior Consultant to InSinkerator

activities.[4] Based on the description of activities permissible in each of the manufacturing zones and the operation of an AD facility (which includes gas production, storage, and possibly combustion), an M3 zone would be the most appropriate zone for such a facility. It is important to note that this assumption is made in the absence of a test pilot and the City may, at a later stage, make a different ruling that allows anaerobic digestion as a "use as a matter of right" in another zone. Otherwise, to site an AD facility in another zone, either a special use permit or a zoning change would be required.

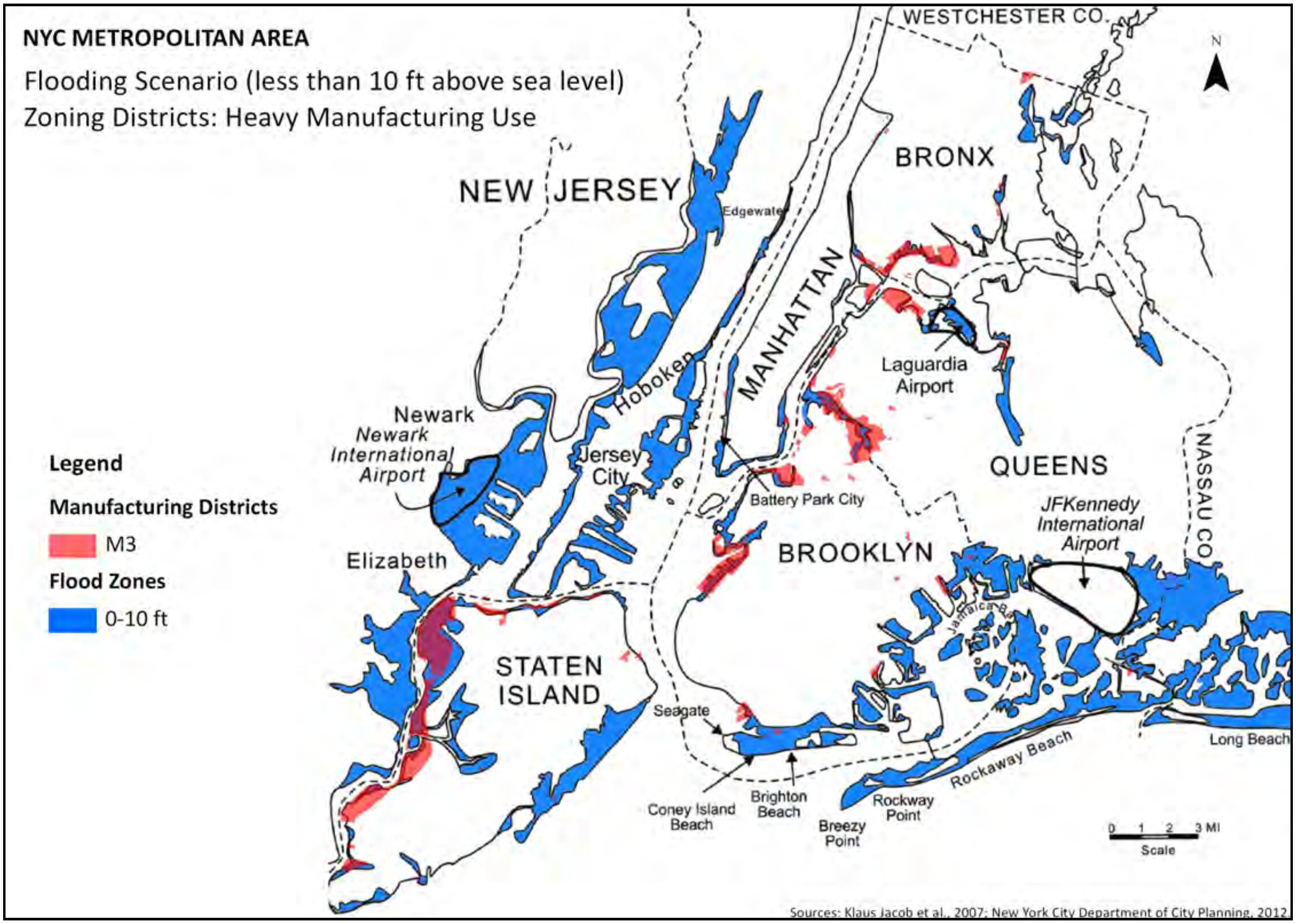
Map 1 (on page 5) provides an illustration of existing M3 zones in NYC. As evident from the illustration, existing manufacturing facilities and transfer stations likely already occupy most of these areas, resulting in limited space for new development. Co-location with an existing facility provides a potential solution. This approach is currently being tested in Oakland, California at the East Bay Municipal Utility District (MUD), an under-capacity wastewater treatment plant, which now also treats food waste. For NYC, co-location presents an attractive option, if sufficient capacity in the City's wastewater digesters exists.

The large amount of M3 zones located in floodplains (See Map 3) may also be problematic for the siting of a digester in those zones. According to the Hunts Point Anaerobic Digestion Feasibility Study, which evaluated the development of AD to process waste from the Hunts Point Food Distribution Center, siting facilities in floodplains incurs "extraordinary costs" for development (New York City Economic Development Corporation, 2010). Specifically, developing in floodplain regions incurs extraordinary costs due to the need for:

- Modification of waterfront structures to protect the AD Facility from erosion during storms;
- Importation of fill to raise the base elevation of the site;
- Soil stabilization additives; and
- Corrosion resistant piles for foundation support

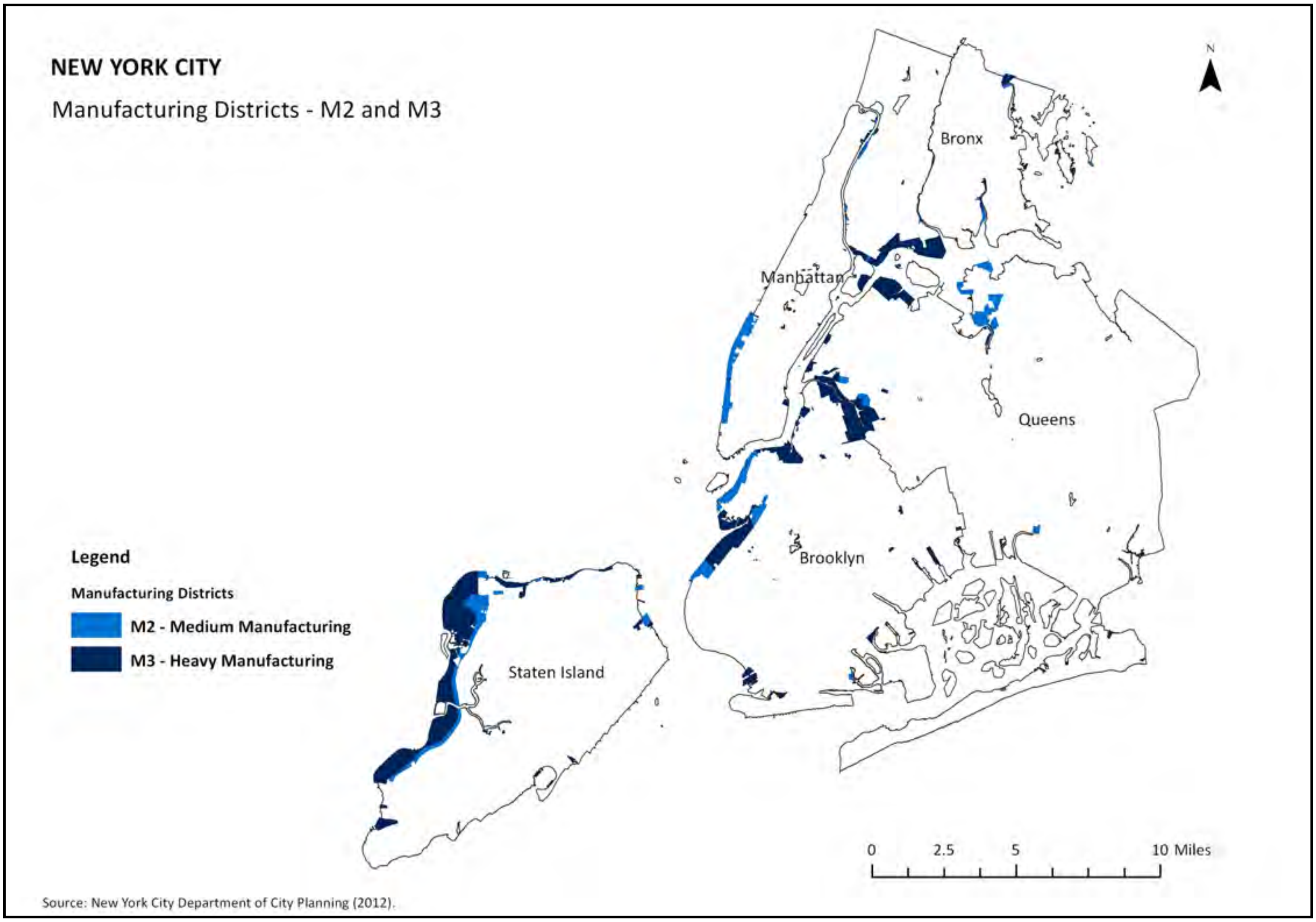
While all of these costs may not always be incurred, they certainly must be taken into account by developers.

Map 3: Floodplains and M3 Zones in NYC



There is also some possibility of placing one of these facilities in an M2 zone. Map 4 shows M2 and M3 zones in NYC. As evident from the illustration, being able to place an AD facility in an M2 zone will greatly increase the possibility of finding a permitted space. As discussed above, to place such a facility in an M2 zone, it will either need to adhere to the stricter regulations of the M2 zone, or it would require a zoning change. To pursue such an option, a developer would have to go through a Uniform Land Use Review Procedure (ULURP), governed by the Department of City Planning (DCP) (See Section IV on ULURP Process).

Map 4: M2 and M3 Zones in NYC



B. Performance Standards

The suitability of a waste processing technology to a given zone will depend on its capacity to meet a set of performance standards as defined in the city zoning resolution (Article IV, Chapter 2). A performance standard is "a minimum requirement or maximum allowable limit" on certain criteria (www.nyc.gov/html/dcp/html/zone/glossary.shtml). The key areas of evaluation for anaerobic digestion are noise, odor, smoke and other particulate matter, and fire and explosive hazards, regulated by the DEP, the DCP, and other agencies.

Noise

Noise in NYC is regulated in the Zoning Resolution and under the City Noise Code by the Department of Environmental Protection (DEP), using the decibel (dB) unit of sound measurement (DCP, 2011). The decibel is measured along a logarithmic scale, which means that a ten-unit increase in dB is associated with a tenfold increase in the intensity of the sound (Vanderheiden, n.d.). NYC regulates the sound emitted during both construction and operation of projects, with construction normally being the louder of the two. Regulated noise levels differ, however, depending on their frequency, which is measured in octave bands, which are spectrums of pitches measured in Hertz

(Zoning Resolution Article IV, Chapter 2, §42-21). Maximum allowable noise levels for each measured octave band in M2 and M3 zones and references to normal activities are found in Appendix 2. A 2006 study commissioned by NYC Economic Development Corporation and DSNY researched several existing anaerobic digestion technologies in other countries and reported no harmful noise issues from operations (ARI 2006 5-11, C-6).

Odor

Odor is measured by the emissions of hydrogen sulfide (H_2S), the compound that gives rotten eggs their smell and is a by-product of degrading food waste. Hydrogen sulfide is detectable at low levels, 4-5 parts per billion (New York City Department of Environmental Protection (b), 2007), and can have serious health effects at high levels above 100 parts per million (Occupational Safety and Health Administration, 2012). NYS regulations limit ambient hydrogen sulfide levels to 10 parts per billion (NYS DEC: Chapter 3, Subpart 257-10).[5] In addition, the CEQR Technical Manual, discussed further below in the Environmental Review section, uses a 1 part per billion standard for wastewater processes (CEQR Technical Manual, 2012). This is especially useful for considering impacts on sensitive receptors such as residences and playgrounds (CEQR Technical Manual, 2012). In M1 and M2 districts, odor emissions must be in accordance with the DEP regulations, which is 10 parts per billion of H_2S. In all three districts, odor emissions in quantities that produce a public nuisance or hazard at or beyond lot lines is prohibited. (Zoning Resolution Article IV, Chapter 2, §42-24). Bio-filters provide one solution to this problem, as discussed in the Technology Chapter of this report.

Smoke and Particulate Matter

Smoke is defined as a visible emission into the open air from any source, except emissions of an uncontaminated water vapor; dust is defined as solid particulate matter capable of being air- or gas-borne; and particulate matter is any finely divided liquid or solid matter capable of being air- or gas-borne. Emission of smoke, dust and other particulate matter associated with combustion for indirect heating (burning of fuel in equipment, such as steam boilers, water or air heaters, stills, or brew kettles, where there is no contact between the products of combustion and the materials being heated) is regulated based on a smoke unit which is the quantity of smoke discharged per minute. The method of measurement for dust from incineration is subject to allowances set by DEP. In addition, to prevent wind-blown air pollution, all storage areas, yards, service roads, or other untreated open areas within boundaries of a zoning lot must be improved with appropriate landscaping or paving, or treated by oiling or any other means to minimize air pollution. Appendix 2 outlines specific smoke and particulate matter performance standards.

Fire and Explosive Hazards

The performance standards in this area are based on the underlying characteristics of the materials. Materials are categorized into four 'classes' based on their burning rate,[6] ignition temperature, and open cup flash point.[7] The zoning resolution outlines a separate set of rules for the manufacturing, utilization and storage of such materials. In addition, there are performance standards associated with the manufacture, storage or utilization of oxygen. It is assumed that an AD facility will have to conform with these strict standards depending on the volume of biogas produced,

the manner in which it is stored, and the manner in which it is used (combusted, compressed, liquefied, etc.).
One recent report commissioned by the California Department of Resources, Recycling and Recovery presented the following analysis: "Biogas is explosive when mixed with air in concentrations of 5 to 15 percent. A leak in a gas line can create a fire hazard if an ignition source is present and the concentration of flammable constituents is at a hazardous level, however, in open spaces biogas readily mixes with air reducing its potential to reach flammable concentrations" (ESA 2011 11-4).

C. ULURP: The Process for a Zoning Change or Exemption

In the event that a developer wants to place an AD facility in a non-M3 zone (e.g., an M2 zone is preferable because of its proximity to food waste sources or other infrastructure), the company will need to gain a special zoning exemption or zoning change. This exemption can only be granted through the Uniform Land Use Review Procedure (ULURP), processed by the Department of City Planning. It is a difficult process, with multiple steps, going through multiple layers of stakeholder approval, with a high possibility of being rejected. This process has five potential levels of review: Community Board, Borough President, City Planning Commission, and in certain instances, the City Council and the Mayor. If there is strong political opposition to the project, it can be rejected at any stage. Appendix 3 provides an illustration of the process with an estimated timetable.

According to Morton Orentlicher, a waste infrastructure specialist in NYC, the biggest hurdle to overcome in siting a facility is gaining support from the local community. Area residents have the power to delay and block infrastructure development that is perceived as having a negative impact on the human and environmental health in the local area. Furthermore, "if the City Council is against the plan, there is no point in trying" (Orentlicher 2012).

The ULURP guidance (Appendix 3) does provide a generic timeline of approximately one year yet developers who have completed the process state that the process can take much longer, and should be factored into the developers' timeframe. It should be noted that this can take place in sync with the environment review process, as well as permitting and community engagement, and therefore a developer should not wait to start the ULURP process if applicable.

III. Environmental Review

The environmental review process involves determining potentially negative impacts a proposed project may have on the surrounding environment, as well as presenting adequate mitigation techniques for any significant impacts identified. Developers in NYC must go through this process to be able to gain the permits required for construction and operation. This process is regulated by one of three review processes, depending on the level of government agencies involved. For projects undertaken by federal agencies or involving funding or permitting by federal agencies, the environmental review may be regulated by the National Environmental Policy Act of 1969. Projects undertaken by state agencies or involving funding or permitting by New York state agencies have environmental reviews regulated by the State Environmental Quality Review Act (SEQRA). However, for projects located in the City of New York, projects undertaken by city agencies or involving funding or permitting by city agencies, the City Environmental Quality Review (CEQR) regulates the environmental review.[8]

A. SEQRA vs. CEQR

The New York City Mayor's Office of Environmental Coordination oversees the City Environmental Quality Review (CEQR), which by law can be no less stringent than its State counterpart, SEQRA (State Environmental Review Act). CEQR is, "the process by which New York City agencies determine what effect, if any, a discretionary action they approve may have upon the environment" (NYC Mayor's Office of Environmental Coordination 2012).[9]

In the case of an AD facility within NYC, discretionary permitting by both City and State agencies may be required, and therefore the environmental review process is regulated by both CEQR and SEQRA. The reference document for this is the City Environmental Quality Review Technical Manual (NYC Mayor's Office of Environmental Coordination 2012). The box below outlines the initial steps

Preliminary Steps for an Environmental Review

1. Designate Type of Action – A government agency categorizes the project by the impact it will have on the environment.

- Type I - Actions that are more likely to have significant adverse environmental impacts
- Type II - Actions that have been determined not to have a significant adverse environmental impact.
- Unlisted - All actions that are not Type I or Type II (these are the majority of the cases)

2. Environmental Assessment – The Developer provides a brief description of the project to all potentially involved government agencies.

3. Lead Agency – From Step 2 a Lead Agency(ies) is/are chosen to oversee the environmental review process. The agency is chosen based on its approved obligations relative to the project (i.e. likely DSNY for AD). There can be other agencies that play an advisory role as well (called "interested" or "involved" agencies, but just one or two lead agencies.

associated with New York's environmental review procedures.

B. Determination of Significance

Whenever there is at least one significant adverse environmental impact identified through in the Environmental Assessment Form, the developer is required to prepare an Environmental Impact Statement (EIS). This is a report that comprehensively analyzes potential impacts and present mitigation techniques to address the significant concerns. In this case, the public participation is a key component of the environmental review, and the communities as well as other agencies involved are invited to have active presence in the review process so that every concern is addressed. Determining the significance of a project will pique all the communities' social and environmental concerns, and may require a more reasonable approach from the developers to overcome and ease any potential obstacles.

In this regard, some project developers have avoided the significance determination step (including preparation of the Environmental Assessment Statement), and have gone directly to the preparation of an EIS, being conscious of legal requirements, potential impacts and mitigation techniques, as well as having active community participation. This approach will serve to expedite the entire environmental review process, as well as save money.

C. Environmental Impact Statement

As stated above, the Environmental Impact Statement is part of the environmental review process where the mitigation strategies are described. The process is made up of a scoping stage, preparation of a draft report, and a final EIS document. Public review and comment is required at various stages. If the project is in the City, it will imply both State and City processes. These processes may be undertaken simultaneously (CEQR Technical Manual).[10] The scoping process is a critical part of the public engagement process. The public is given notice of the project's description and provided the opportunity to comment and offer valuable feedback. This allows a final definition of the scope of work that the EIS must follow in order to assure all concerns are being addressed.

The permitting process is a legal framework to assure compliance with standards and practices established by government agencies. These are requirements in addition to the performance standards discussed above. Further, under, 6 NYCRR §360-1.9(e)(4)(v), the State requires applications for the construction or expansion of a solid waste management facility to demonstrate consistency with the SWMP.

IV. Permitting

The environmental review process described above informs the permitting process. A discretionary permit may only be issued if the environmental review process is completed. However the permit application process may begin as soon as the most significant impacts have been identified. Before an AD facility can be constructed and operated, a series of permits must be obtained from both city and State agencies. The permits fall into the following four general categories:

Water Supply and Discharge

There are strict regulations that outline the criteria for a permit to use or dispose of water from a new facility (6 NYCRR Part 703). All effluents should comply with minimum requirements before being discharged in to the sewer system (NYC DEP Bureau of Water and Sewer Operations). In a similar vein, the 6 NYCRR Part 601 states the criteria for a water supply permit, if required. It has been found that the AD processing facility water requirements vary widely depending on the technology used, and many AD technologies can recycle their wastewater (See the Technology Chapter for a more in-depth discussion), which would aid in meeting the minimum waste requirements and reducing the water supply needed to process the food waste digester. Further research is needed to determine the specific discharge limits corresponding to the areas that are served by different wastewater treatment facilities, and discharge into different receiving waters.

Air

Air pollution refers to the emission of contaminating substances from any source that may present an adverse impact to the environment (EPA Clean Air Act). The Uniform Procedure Act (UPA) establishes a classification, (major or minor), according to the project's characteristics. Based on the research presented in the previous chapter, emissions from the combustion of gas should only be considered minor sources of pollution, especially in light of the determination that the combustion turbines will be small. After we conducted a detailed literature search on air emission from anaerobic digestion, very little data was found on emissions from facilities in operation. While specific pollutants are expected prior to emissions control processes, it is expected that emissions control technologies outlined in Appendix 1 can potentially reduce these air emissions. More research is needed to determine the operational performance of these emissions control technologies for facilities in operation. Therefore, only state regulations for air emissions would need to be fulfilled, rendering federal involvement unnecessary. A facility must possess an air pollution control permit under the current state regulations, 6 NYCRR Part 200, which will state full compliance of the control systems and mitigation techniques of any atmospheric emissions.

Solid Waste Facility

Based on the assumption that an AD facility will likely fall under the category of a composting solid waste management facility, the construction and operation of such a facility must comply with all the regulations and guidelines outlined in 6 NYCRR Part 360 and the New York State Department of Environmental Conservation Regulations Policy DMM-SW-09-01. If, however, the AD facility is classified as another type of solid waste management facility, which, given the uncertainty surrounding the definition of AD, is possible, different standards may apply based on the other characterization. For example, there may be an argument that the AD facility with its combustion technology (microturbine, fuel cell, etc.) would be considered a refuse-derived fuel facility.

Coastal Zone Protection

Under the framework of the New York City Waterfront Revitalization Program, the City's policies for development and use of the waterfront (Department of City Planning, 2002), and given the fact that most of the M3 zones are located in coastal areas, it is imperative ensure proper planning in accordance with the waterfront protection (19 NYCRR Part 600 to 603). This is crucial, as the Waterfront Revitalization Program requires the consistency of proposed actions with the policies outlined in the Waterfront Revitalization Program (19 NYCRR Part 600.1 (a)). In this case, whenever a new facility is being developed in a waterfront area it must be in accordance with the current coastal protection regulations.

In addition to the general categories mentioned above, there are possible additional *ministerial* permits that may apply to such a facility the analyses of which are outside the scope of this document. Ministerial permits are those that do not require any sort of discretion to be issued (Department of Environmental Conservation, n.d.). Construction and plumbing permits are used to comply with existing building regulations and are a required first step within the scope of any development project. Similarly, if any hazardous substance or waste is manipulated within the project's premises, an emergency plan will be required by the New York City Fire Department (3 RCNY 202-01) and possible cleanup will be required by the New York State Department of Environmental Conservation (DEC) (6 NYCRR Part 375).

Specific permits and requirements will vary based on the nature and design of a specific project. As stated above, no permit may be issued until the entire environmental review process is completed. The table below provides an overview of possible permits required for a food waste processing facility.[11]

Table 4: List of Permits Required

Category	Permit Name	Regulations	Authority Level
Water Supply	Public Water supply permit	6 NYCRR PART 601- ART. 15 Title 15, Environmental Conservation Law	DEC
Water Discharge	Storm water Pollution Prevention Plan	GP-0-10-001	DEC
	Multi-sector General Storm water Permit	GP-0-11-009	DEC
	Sewer Certification and Connection Permit	Model Sewer Use Law	NYC DEP Bureau of water and sew-er operations
Waterfront	Water Revitalization Program	19 NYCRR Part 600 to 603	DCP/NYS Depart-ment of State
Air	Air Pollution Control	6 NYCRR Part 200	DEC/DEP
Noise	Noise Mitigation Plan	15 RCNY Section 28-104	NYC DEP
Solid Waste	Part 360 Solid Waste Permit	6 NYCRR Part 360; City Siting Regulations	DEC / DSNY
Plumbing	Plumbing Work*	Construction Code §28-408.1 and §28-410.1	NYC DOB
Hazardous Substance	Building Emergency Plan*/ Cleanup Program	Fire Department 3 RCNY 202-01; 6 NYCRR Part 375	New York City Fire Department/ DEC

V. Community Engagement

The previous sections of this chapter have outlined the regulatory and policy elements associated with siting an AD facility in NYC. One of the two key tasks in this report in addition to siting and permitting is community engagement. Community engagement actually plays an integral role in the permitting process.

It is important to note that the community in which the facility will be located is an important element affecting both siting and permitting. Community engagement guidelines recommend that members of the community should be involved in decision-making and problem solving (Tamarack Institute). According to a report by the EPA, "establishing credibility and trust with the public is as important as addressing the environmental, social, and economic concerns about the… facility" (USEPA, 2002). Effective community participation can bring many advantages to the implementation and operation of a project. Engagement with communities allows developers to access local knowledge, enable improved decision making, and understand and develop plans to address possible negative impacts before they escalate into roadblocks.

As the chapter on community engagement points out, there are a variety of specific benefits that can be attained for developers through effective community engagement. Conversely, community opposition can grind development projects to a halt, costing time, money, and often preventing construction and operation (Copeland). Clear cooperation and a good host agreement, however, may provide an important partner for developers and ensure the project's completion. Any developer should actively engage in a comprehensive community engagement plan as outlined in the community engagement chapter to minimize opposition and ensure a streamlined implementation process.

VI. Uncertainties

Anaerobic digestion provides a technological solution to managing food waste. This chapter has outlined the procedures associated with siting, zoning, environmental review, and permitting the activation of such a facility in NYC. It has also outlined several uncertainties with regard to the specific regulations and policies that would be applicable in such a case. In addition to the uncertainties stemming from the absence of guidelines on the categorization of an AD facility within potentially applicable regulations and performance standards, there are other sources of uncertainty that must be considered.

In the United States, Anaerobic Digestion technology is currently predominantly used at wastewater treatment facilities and at livestock farms for manure management (WA Dept. of Ecology, 2012). An EPA survey indicated that over 147 digesters are being used for manure management at farms (WA Dept. of Ecology, 2012). Information on facilities using this technology in a metropolitan area within the United States to manage food waste is very limited. The EPA highlights the East Bay Municipal Utility District (EBMUD) project in Oakland, California a pioneering project in the United States (EPA, 2012). The fact that this technology is not already widely in use for food waste management poses an area of uncertainty. There will be a steep learning curve associated with developing the optimal usage of the technology, specifically in the context of an urban setting. Further, without the lessons learned and associate track record from prior projects, it will be harder to anticipate and predict outcomes. If, despite all these challenges, a developer is able to demonstrate that a food waste AD facility has a positive impact that can reduce the effects of long-distance waste transportation while providing valuable outputs, it will have a technology with huge potential for upscaling and replication. Working with the government and the public to set new guidelines and rules where necessary will streamline the process and ease the development of future AD projects.

Community Engagement

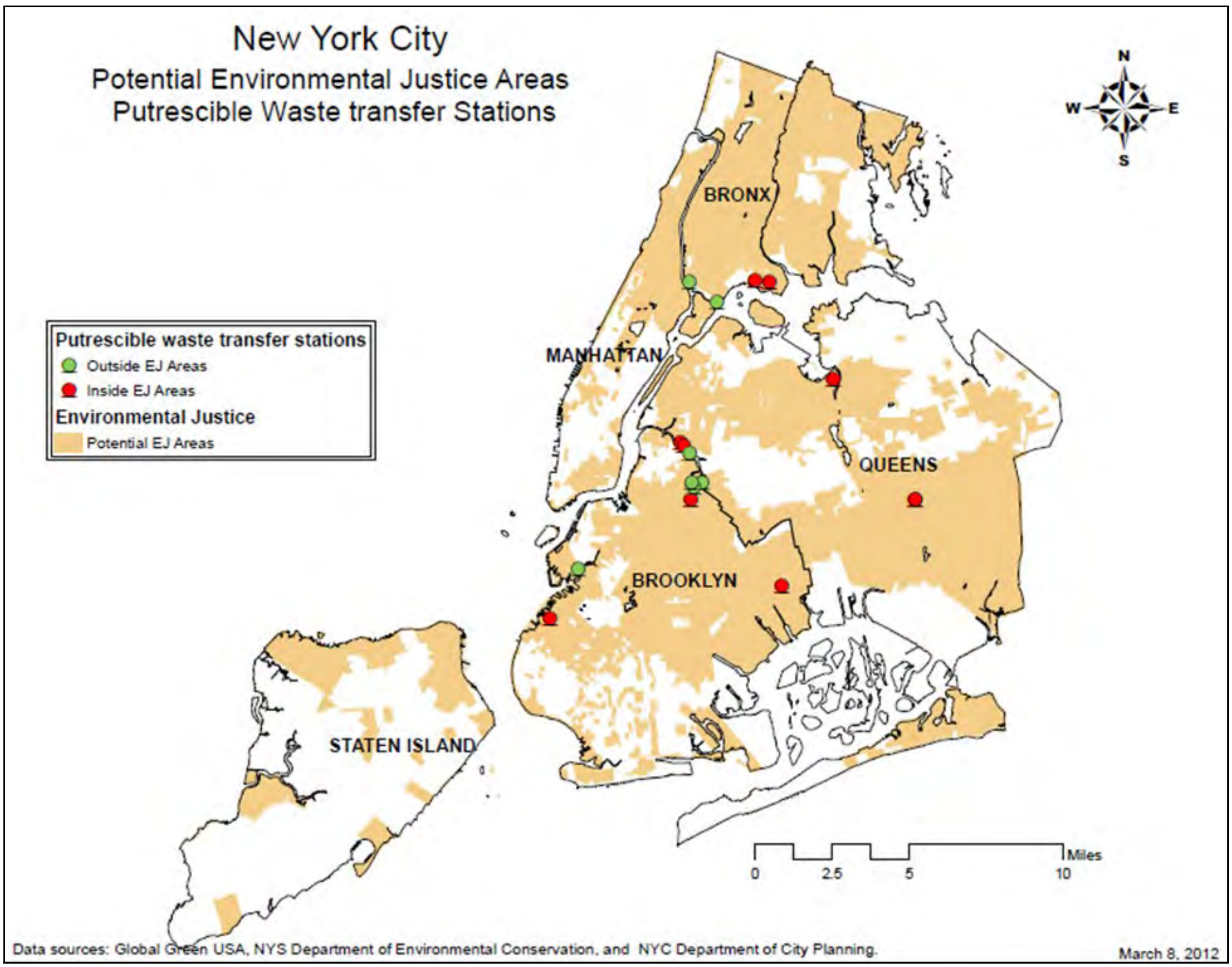
Introduction

Community engagement – the process of informing and working with the impacted communities surrounding a project site – is another essential component of a comprehensive development framework. Like permitting and siting, it is a necessary step that all developers must take, regardless of the project size, to ensure successful construction and operation of a food waste processing facility. Waste disposal in particular remains a very sensitive issue for communities throughout NYC, reinforcing the importance of effective engagement to not only limit detrimental impacts, but to also mitigate and even prevent opposition that can severely hinder projects.

I. Community Perceptions of Waste Facilities in NYC

It is well documented that racial minority and low-income communities often bear a disproportionate burden of urban environmental problems (Martuzzi et. Al, 2009). Commercial waste disposal practices in NYC have been no exception. Much of the

Map 5: Potential Environmental Justice Areas and Putrescible Waste Transfer Stations in NYC.



A potential environmental justice area is defined as an area meeting the following criteria (NYS DEC, 2003):

- At least 51.1% of the population in an urban area reported themselves to be members of minority groups; or
- At least 33.8% of the population in a rural area reported themselves to be members of minority groups; or
- At least 23.59% of the population in an urban or rural area had household incomes below the federal poverty level.

commercial waste generated in NYC is trucked to waste transfer stations located in minority and/or low-income communities and then loaded onto larger trucks for shipment out of NYC. The problems and concerns associated with these transfer stations are germane to many waste management sites in NYC and are therefore pertinent for developing any type of food waste facility. In particular, the neighborhoods of Williamsburg and Greenpoint in Brooklyn, and much of the South Bronx contain high concentrations of waste transfer stations. In contrast, Manhattan has no private transfer stations despite the fact that 40% of the city's putrescible commercial waste is generated in Manhattan (NYCDS, 2006).

All waste processing facilities and transfer stations have a range of environmental impacts associated with them, many of which adversely affect the communities where they are sited. Areas that have high concentrations of waste and/or other industrial processing facilities are particularly vulnerable to these environmental impacts due to the cumulative effect of multiple facilities (Sze, 2007). Any expansion of these facilities that could potentially add to these impacts would obviously be of significant concern to these communities.

In NYC, a significant problem arising from transfer stations and other waste facilities is increased truck traffic (Sze, 2007). This matter is particularly pertinent in communities where there is only one access route. For example, in Greenpoint/ Williamsburg the high volume of truck traffic is aggravated by the Brooklyn Queens Expressway and Williamsburg Bridge. Community members in Greenpoint complain about trucks traveling at high speeds and the high rate of accidents (NYCDS, 2006). Hunts Point in the South Bronx also hosts a high volume of truck traffic. Expressing the sentiment of the neighborhood, Blanca Ramirez, a staff member of the Mercy Center – a community center for women and their families in the South Bronx – wrote, "The trucks, the trucks. We have enough garbage trucks here. To say, 'It's O.K., you can dump more garbage in the South Bronx, especially Hunts Point' -- when is fair going to be fair?" (Ramirez, 2008).

One concern surrounding the large volume of truck traffic is the potential danger to pedestrians, particularly to children and the elderly (Sze, 2007). Residents living near transfer stations are also worried by the impact on public health from increased diesel fuel emissions resulting not only from increased trucking but also from the high number of trucks idling as they wait to unload. These concerns are especially germane in the South Bronx where asthma rates are already high (Restrepo, et al.). Another concern that communities cite is weak enforcement of regulations dictating truck routes and loading/unloading times. Residents report that trucks are rarely

Figure 6: Garbage Truck Repository (Whistlingoutloud, 2006).

properly covered, often stray from the designated truck routes – instead using residential streets – and engage in illegal fly-by-night operations (DSNY, 2005).

Another problem with transfer stations raised by community groups is the potential negative impact on local economic development. Communities claim that transfer stations impede community efforts to develop high-quality employment (Sze, 2007). Long-time Bronx resident Marian Feinberg and member of the South Bronx Clean Air Coalition stated that at many transfer stations the working conditions are poor and often non-unionized laborers work for low wages in dangerous environments (Sze, 2007). According to Sze, transfer stations can also disrupt community efforts to develop attractive housing as transfer sites can deplete the value of the surrounding land (Sze, 2007).

Communities can be particularly wary of transfer stations serviced by private companies. They assert that that when garbage is viewed as a valuable product it results in a loss of incentive to reduce waste. "There is a morality play here… when garbage is looked at as gold," said Paul Lipson, former executive director of the Point Community Development Corporation (Waldan, 1999). Some community members also believe that by contracting through private companies, profit margins come at the cost of lowered wages for workers and disinterest for the consideration of the community (DSNY, 2006). Furthermore, community members assert that many contracts have been awarded to companies that have violated environmental laws in the past (Sze, 2007). Communities also claim that the environmental review required of these private communities is too lenient and often inaccurate (NYCDS, 2006).

Other community concerns involve the transfer sites themselves. Community complaints concerning NYC waste transfer stations have included the creation of bad odors, noise, and problems with pests (rats, cockroaches, etc.). Additionally, the loss of open space and the impact upon neighborhood aesthetics are also cited as problematic (WE ACT, 2011).

II. Principles of Community Engagement

For the reasons mentioned above, siting of any class of industrial facility (waste processers, power plants, etc.) is a sensitive process, and one that necessitates significant community involvement through the process of community engagement. Community engagement, involving community members to find solutions for issues that affect them, is a growing practice amongst developers of industrial facilities (Tamarack Institute, 2011). It involves becoming knowledgeable about a community and their concerns, as well as establishing meaningful relationships with community leaders. This includes fostering an open, two-way, dialogue with residents and developing partnerships to address their concerns. It requires commitment and flexibility on the part of the developer.

In a world where societal challenges are becoming increasingly complex, the process by which institutions, both public and private, make decisions requires ever more input from stakeholders and citizens (Tamarack Institute, 2001). Currently, within the growing field of sustainable development, it is recognized that as the outcome of any planning system affects many stakeholder groups, it follows that those affected should have the opportunity to play a role in developing the planning system (Enabling

Food Waste Reduction First

Many community groups advocate for curtailing food waste before it ends up in the garbage. Americans throw out 25 percent of the food they prepare, (Sodexho, 2010) and while some amount of food waste is inevitable, these high levels of food waste can be significantly reduced through more efficient management of food materials (EPA, 2010). New York State's DEC website states "waste reduction is first in the hierarchy of waste management and focuses on the prevention of solid waste generation through changes in products, packaging and purchasing (NYSDEC, 2012)." The EPA suggests that organizations in the commercial food sector can reduce their waste streams by conducting waste audits, considering secondary uses for excess food, controlling portions, and making menu modifications, among other strategies. In NYC, organizations like City Harvest collect food from restaurants, grocers, corporate cafeterias, manufacturers, and farms, using the food to feed the hungry rather than let it go to waste (City Harvest, 2011).

Projects, 2010). Consequently, broad public participation in decision-making is a fundamental prerequisite for achieving mutually compatible, sustainable development (Enabling Projects, 2010).

Community engagement is an important means to integrate environmental justice and distributive justice considerations into the siting and/or expansion of industrial facilities (EPA, 2002). Kathryn E. Freed, a City Council member from the Lower East Side stated, "It's really an important decision for any kind of disadvantaged or minority community, because they're always the ones who get dumped on," (Waldman, 1999). Effective community engagement can mitigate some of the perceptions and real problems concerning the disproportionately high, adverse environmental, health and economic effects of a project on minority and low-income populations (EPA, 2002). However, the benefits of community engagement tools are not only restricted to environmental justice communities. Effective community engagement can bring many advantages to all communities including improved decision making processes and a reduction of some of the possible negative impacts of a project. Similarly, successful community participation can also lead to very favorable results for developers. It can serve as a means to combat "NIMBYism," and other forms of community opposition, which can grind development projects to a halt, costing time and money. Clear and transparent cooperation can ensure the project's completion in a way that benefits both parties.

Figure 9: The Staples Center in downtown Los Angeles (Mbroh, 2004).

Staples CBA – Los Angeles, California

The Staples agreement, signed in 2001, was one of the first comprehensive CBAs, and also one of the most prominent examples of successful large-scale community engagement. In order to ensure community benefits, a CBA was negotiated between the developer and the Figueroa Corridor Coalition for Economic Justice (FCCEJ) – representing over 30 community and labor organizations (Salkin, 2008).

Strong community representation and developer willingness to maintain active participation resulted in a CBA with unprecedented benefits. Some of the specific benefits of the CBA that were meant to achieve this goal included (Staples Center, 2001):

- $1 million committed for the creation or improvement of parks and recreational facilities
- $25,000 per year for a term of five years for the creation of a residential parking permit program
- 70% of the jobs created in the project will pay the City's living wage
- $100,000 in seed money for a local hiring program and preferential hiring for low income individuals and those displaced by the project
- 20% of the residential units in the project be affordable
- $650,000 in interest-free loans to non-profit housing developers for the creation of additional affordable housing

Reasons for Success

- *Intricate and representative community involvement*: The FCCEJ represented a wide range of community interests, providing a platform for varying opinions to be voiced. This allowed the developer to address specifically identified needs and concerns regarding the project and prevented the CBA from marginalizing some residents and creating opposition.
- *Flexibility*: The CBA stipulated that implementation would be assessed after five and ten years and since its original signing the parties have mutually changed certain provisions in response to the changing needs of the community. This flexibility ensures that the CBA continues to be effective and beneficial through regular adaptation to the requests of both parties (Salkin, 2008).
- *Continued support and communication*: The CBA included a provision that established an Advisory Committee comprised of representatives of both the developer and coalition to assist with implementation, address environmental concerns, and facilitate open dialogue (Staples Center, 2001). The CBA stipulated that this committee would meet quarterly throughout the development.
- *Enforceability*: A month after its signing, the CBA was incorporated into the development agreement between the developers and the Community Redevelopment Agency, making it enforceable by not only community groups, but by the city government (Salkin, 2008).

III. Community Engagement in New York City

The importance of community engagement has been recognized in New York, both on a state and city level. On the state level the Department of Environmental Conservation (DEC) has put into place Commissioner Policy – 29 (CP-29), a policy requiring that all developers initiating projects in NYS create a Public Participation Plan if their project is on a site deemed a potential environmental justice area (NYSDEC, 2003). Issued in 2003, CP-29 offers the minimum of what should be required in a community engagement plan. According to CP-29, a community participation plan must include the identification of stakeholders, the distribution of written information about the proposed project, informational public meetings, and the creation of a document repository (NYSDEC, 2003).

Additionally on the state level, the recently signed Power NY Act of 2011 re-established Article 10 of the Public Service Law requiring the DEC to promulgate regulations for the analysis of Environmental Justice Issues when siting power plants (NYSDEC, 2012). In response the DEC has proposed regulations in 6 NYCRR Part 487 which establish a regulatory framework for analyzing environmental justice issues which developers must include in their application for the required Certificate of Environmental Compatibility and Public Need (NYSDEC, 2012). These regulations were proposed to address lack of early meaningful public participation, unavailability of information, and the failure to address community concerns in current siting processes. The proposed regulation requires that developers include the following components in their assessment:

- an evaluation of significant and adverse disproportionate environmental impacts of the proposed facility
- a cumulative impact analysis of air quality
- a comprehensive demographic, economic and physical description of the community within which the facility will be located, compared and contrasted to the county and adjacent communities (NYSDEC, 2012).

On the city level, the recent Request for Proposal (RFP) issued by the DSNY for new and emerging solid waste technologies included detailed requirements regarding community participation on behalf of the developer (NYCDS, RFP, 2012). Within the document, it is outlined that proposals must include a public information and participation plan that complies with DEC guideline, CP-29 (DSNY, RFP, 2012). It is clearly stated that this plan must describe the target audiences for information, educate the host community about the project, describe the method by which information will be shared with the public, provide meaningful opportunities for involvement, and designate the types of personnel that will carry out this outreach. According to this RFP, any participation plan must also engage the public as stakeholders during the planning, approval, implementation, construction, testing, and operating phases for both the pilot and expanded facility. Furthermore, the RFP lists a variety of forums for public discussion during the development of a project plan, including: public education centers, meetings with the public, community leaders, and public officials, hotlines, a website, and an annual report on progress. The developer will initiate all of these efforts during the Initial Development Period (NYCDS, RFP, 2012), an effort that goes well beyond the requirements of CP-29.

IV. Framework For Community Engagement

Based on the above community concerns, current research, and the environmental justice environment in NYC, we created a three-step framework for developers to use when siting a facility; a community engagement plan that goes beyond the basic requirements of CP-29.

When using this framework it is important to remember that Community Engagement is a dynamic process (Enabling Projects). Objectives may change as a consequence of the learning and information exchange from interacting with various stakeholders (Enabling Projects). Stakeholder lists should not be static documents but instead should be ever expanding as more stakeholders come forward. Additionally, community engagement is not a onetime event; it is a continuous process (Enabling Projects). Developers need to thoroughly reach out to communities at every step of the process.

A. Identify Stakeholders

In complying with DEC Commissioner Policy–29, the first step developers must take is to identify the stakeholders within the community, i.e. individuals or organizations that will be either directly impacted by the proposed facility or potentially affected by its operation in the future (NYSDEC, 2003). Part of this process includes determining the demographic makeup of the community, especially the income level and ethnic makeup of the area (NYSDEC, n.d. and USEPA, 2002). Though each community varies, common stakeholders include:

- Residents and neighborhood groups
- Community boards, community leaders, and local civic and recreational organizations
- Local industry and business
- Environmental justice groups
- Local and state elected officials
- Academic institutions
- Local Media

B. Design Engagement Approach

It is helpful for developers to approach community participation using three different methods: informational, responsive, and collaborative (USEPA, 2002). The informational method involves educational outreach to the community regarding the project and its impacts; the responsive method invites members of the community to partake in public meetings and discuss the development of the food waste facility; and the collaborative method creates a partnership between the developer and the community in the decision-making process (USEPA, 2002). Although the current law in NYC only requires developers to pursue the first two aspects of engagement, it is recommended to pursue all three simultaneously in order to ensure an expedient permitting process as well as the long-term success of the project.

Informational Method

It is important and required under CP-29, for the developer to implement educational outreach programs to inform the public on the impacts – environmental, economic, and social – of constructing and operating a food waste facility in the community. Efforts include:

- Informative literature – such as flyers, pamphlets, newsletters, and direct mailing
- Presentations to neighborhood groups

Stakeholder	Description	Role	Groups in New York City
Environmental Justice Organizations And Community Organizations	Community-based organizations that work to assure meaningful participation in the development, implementation and enforcement of environmental laws, regulations, and policies."	Coordinate advocacy efforts to improve the quality and health of the local communities.	WEACT ● New York City Environmental Justice Alliance ● Organization of Waterfront Neighborhoods ● New York Lawyers for the Public Interest – Environmental Justice ● Residents for Sane Trash ● Greenpoint Renaissance Enterprise Corporation ● Sustainable South Bronx
Community Boards	Community boards (CBs) are local representative bodies responsible for improving the delivery of City services to the district. CBs assess the needs of their community members and meet with City agencies to make recommendations in the City's budgeting process. They may also perform other duties, including processing permits for block parties or managing special projects such as neighborhood cleanup programs. Board meetings occur once a month and are open to the public.	CBs have an important advisory role and must be consulted on the placement of most municipal facilities. Applications for a change in, or variance from, the zoning resolution must come before the board for review, and the board's position is considered in the final determination. It is important to note that while CBs serve as advocates for their neighborhood, they do not have the ability to order any City agency or official to perform any task.	In each borough there are between 3 to 18 community boards. To find a community board of a local community visit http://www.nyc.gov/html/cau/html/cb/cb.shtml.
Academic Institutions	Educational institutions dedicated to education and research.	As research institutions, universities play a leading role in developing and transmitting new technologies, as well as partner with communities to support community research. Additionally, universities educate social leaders and spearhead community outreach efforts.	The Center for Urban Environmental Reform (CUER) at the City University of New York School of Law ● The Columbia Center for Children's Environmental Health (CCCEH) at Columbia University's Mailman School of Public Health ● New York University Center for Sustainable Built Environment ● Department of Health and Mental Hygiene ● Children's Environmental Health Center at Mt. Sinai
Locally elected officials and city government agencies	A complex system of locally elected and appointed officials, councils, agencies and offices.	Local government monitors the operation and performance of city agencies, makes land use decisions, grants permits, and creates as well as enforces regulations.	Department of City Planning ● Department of Environmental Protection ● Office of Environmental Coordination ● Mayor's Office of Long Term Planning and Sustainability
Local industry and business	Pre-existing industrial facilities and businesses that are located in the area.	Local businesses have a stake in the siting process as any development in the community will have a lasting economic impact on their activities.	Various; depending on area.
Local Media	Locally-based newspapers, radio stations, television stations and internet sites.	Local media provides a source of information about projects to the local community and the general public. They can carry notices of public meetings and attend the proceedings.	• New York Times • NYdailynews.com • El Diario • Newsday

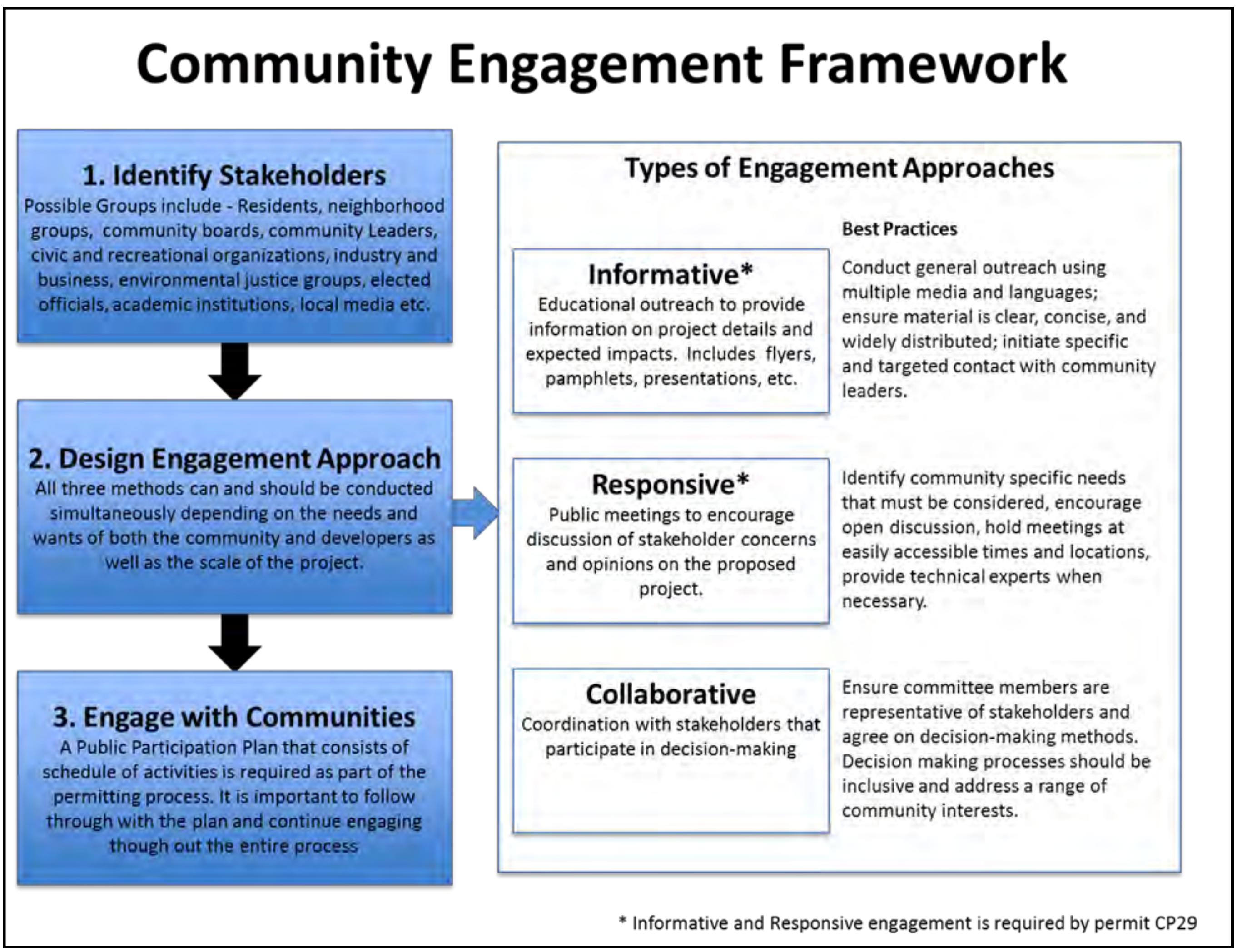
- Media announcements
- Community workshops
- Establishing an internet site

(USEPA, 2002 & NYSDEC, 2002)

Developers should ensure that information is clear, concise, and avoids confusing legal terminology. The information should be widely distributed, translated from English when necessary, and highly visible throughout the community (NYSDEC, n.d.). It is key that the developer builds trust through credible informational material and presentations. Direct contact with specific members of the community is often beneficial because it shows openness and prevents the spread of misleading secondhand information (USEPA, 2002). Distribution of information door to door throughout the community also helps with building trust and transparency with residents (NYSDEC, n.d.). Overall, information must be provided early, with clear accessibility to establish fruitful community relationships.

Another necessary part of the informational method of engagement is the establishment of a document repository that contains all information pertinent to the proposed project and is updated regularly. Ideal locations are easily accessible to stakeholders and close to the development such as a public library or community organization office. Although only one repository is required under CP-29, developers may also wish to create a second repository online (NYSDEC, n.d.).

Figure 7: Community Engagement Framework



Responsive Method

As part of the community engagement process under CP-29 developers must also hold informational meetings throughout development of the facility to keep the public abreast of the current permitting situation, as well as to allow stakeholders to voice their concerns on the project. Developers should encourage dialogue and explore a variety of formats for these meetings to find out what works best for the given situation. Time, location, and content of these meetings should be established early on in the development process to ensure significant attendance and discussion (NYSDEC, n.d.). General guidelines include provisions that the meetings are:

- Held at a time that working people can attend
- Held in a familiar location such as municipal hall, school, fire station or library
- Easily accessible to disabled residents
- Announced agenda at the beginning of each meeting
- Meetings can vary in content, but should be focused on a specific aspect of the development or its impacts
- Include third party experts and mediators when necessary
- (NYSDEC, n.d. and USEPA, 2002).

Lastly, it is important that developers provide effective notifications of these meetings. All necessary information should be clearly displayed and newspapers and public transportation should be utilized for advertisements.

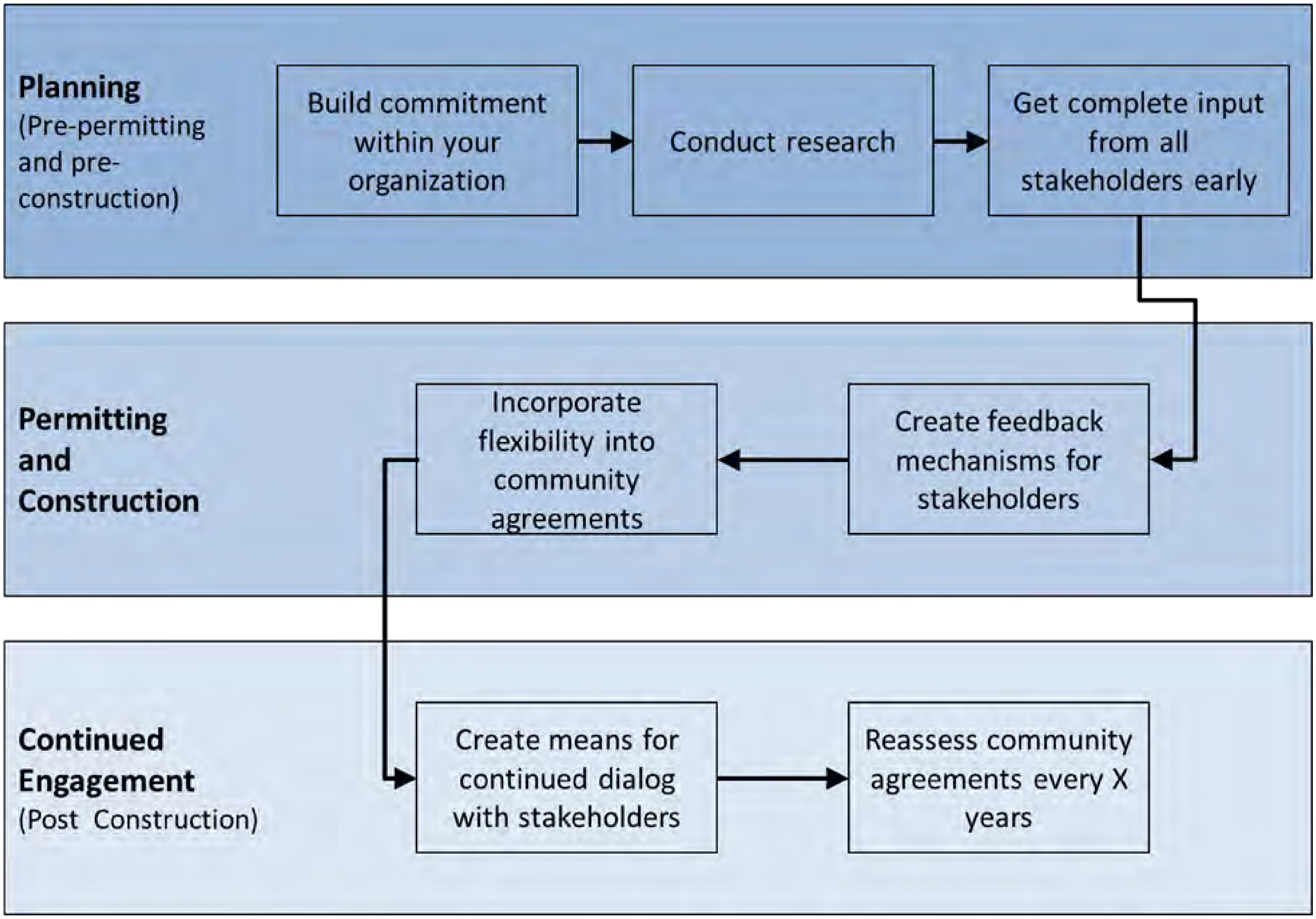
Collaborative Method: The Public Participation Plan

Aside from the distribution of informational literature and holding public meetings, developers can allow community members to participate even more in the decision-making process, commonly completed through the use of a public participation plan. For every project this process will be different, but as part of the permitting process any public participation plan must include a schedule of activities. There is no best way to allow community members to participate (RTPI, 2012), however, in general a successful participation plan will have the following elements: (figure 8).

1. *Make an organizational commitment to pursue community participation*. Public relationships are built over time and require strong organizational commitment and motivation. Commitment requires adequate personnel and financial resources dedicated to working with the public. An effective approach will involve estimating the costs of community participation and committing to covering them. (Alexandria, 2004)

2. *Conduct research*. It is important to understand as much as possible about the communities in order to identify what will motivate people and establish goals (RTPI, 2012). Research the local communities and groups who might be affected, including the historical context, demographics and its connections. Additionally, researching community preferences in terms of communication with the developer is essential for understanding what the best options are for distributing information and holding meetings (Alexandria, 2004). The community will appreciate developers choosing options that operate in the public's interest, such as holding evening meetings in neighborhoods rather than daytime meetings at the site. It is also important to research community expectations. Waste management is a public service, provided, directly or indirectly, by public agencies and often times there is a society-held expectation that public programs should have significant public input and participation. Developers should understand that citizens expect and feel it is their right to give input and participate whenever they choose,

Figure 8: Elements of a Public Participation Plan. It's essential to note that this is meant to be a dynamic rather than a static order.



even if they initially appear uninterested (Alexandria, 2004).

3. *Get complete input from all stakeholders early.* To ensure that decisions garner the most support, developers need input from a variety of stakeholders (RTPI, 2012). Input should start at the beginning of the process and come from representatives from local and regional environmental groups, community leaders, and people from neighborhoods in close proximity to a possible facility (Alexandria, 2004). Such a group would have the best chance of devising a workable plan that would be defended by a wide variety of stakeholders (Alexandria, 2004). A common practice amongst waste treatment facilities is to operate "below the radar," a premise based on the assumption that if no attention is drawn to their actions, there won't be any public rebuke or outcry (Alexandria, 2004). This approach can be detrimental in the long-run because under these circumstances public interest and participation is initiated by complaints, creating a negative start to the public interest and involvement (Alexandria, 2004). Community agreements tend to be more successful when developers proactively seek public interest and involvement early before complaints can begin (Alexandria, 2004).

4. *Create feedback mechanisms for Stakeholders*. It is important to hold regular meetings where stakeholders will be informed of the details of the proposed facility – its purpose and role in waste management, its

byproducts, potential community impacts, and technical aspects – and be given the opportunity to express their concerns to the developer and collaborate on decisions regarding the facility's development (USEPA, 2002). The "Decide-Announce-Defend (DAD)" approach should be avoided (Alexandria, 2004). The DAD approach, which has historically been common practice, involves "experts" (developers who may know the project intimately but aren't representative of the community), making decisions and then educating the public so that they will accept the decisions (Alexandria, 2004). Generally when new technologies are introduced people have an inherent anxiety and uneasiness about the possible risks involved. Given this predilection, providing only minimal information and outreach to the public about a project can backfire (Alexandria, 2004). To ensure success of a project developers must provide clear, direct, complete, and useful communication to the recipient at all times; during non-conflict times, as well as times of tension. Allowing opportunities for key stakeholders to ask questions and voice their opinion is another way to assuage fears and concerns. Good information and communication do not take undue amounts of time or energy; simply following the community engagement protocols before the trucks roll down the street can help significantly (Alexandria, 2004). Ultimately, it's a matter of courtesy, showing that you understand and respect needs and concerns of the community housing the project.

5. *Establish a representative public committee.* A frequently used method of collaboration in development projects is establishing a public committee – a group of community members representing key stakeholders. Ideally this committee will have regular meetings where they will be informed of the details of the proposed facility, including the project's purpose and role in waste management, its byproducts, potential community impacts, and technical aspects. This also allows the community to express their concerns to the developer and collaborate on decisions regarding the development of the facility (USEPA, 2002). It is important that the expectation and limitations of the committee are clearly communicated from the outset and that the rules of discourse, schedule, and procedures for final decision-making should be explained and determined (USEPA, 2002).

6. *Incorporate flexibility into processes.* Processes should not be static. Less rigid decision-making is a way to ensure continued success. Assessing agreements decisions after 1, 3, 5, and 10 years allows for both parties to change certain provisions in response to the changing needs of the community and/or facility (Gross, 2008).

7. *Create means for continued dialog with stakeholders and reassess agreements every few years.* It is important to continue engaging the community even after the application for the project has been submitted and approved (RPTI). One reason is that communities can act as ambassadors for a developer, either enhancing or damaging the reputation of the developer (RPTI). Annual reports, quarterly meetings, maintaining a hotline and an advisory committee all can help to maintain consistent dialogue regarding the concerns of both parties and keep both parties happy (Gross, 2008).

Additionally, implementing the plan requires diligence and flexibility:

1. *Create positive public perceptions of the project.* If something is going well, publicize it so that people notice. Continuing to project a positive message can counteract the negative impressions that might be generated by the inevitable occasional problem.

2. *Maintain transparency.* Hosting a tour is a simple relationship building tool; it makes a difference because the public becomes aware that the company has nothing to hide and that the people who work there are representative of the community. Open access to information on a website makes a difference because it shows company transparency.
3. *Be trustworthy.* Repeatedly do what you say you are going to do and communicate regularly with those who may be affected. According to a report by the EPA, "establishing credibility and trust with the public is as important as addressing the environmental, social, and economic concerns about the… facility" (USEPA, 2002). Social scientists studying community reactions to developers have noted that in many public debates there typically is a small percentage of the public (~10%) that will vocally oppose a proposed project and another small percentage that will vocally support it (again, ~10%) the remaining majority of the public called guardians (~80%) do not participate much but, if the debate becomes highly visible, will listen to both sides of the discussion (Ozawa and Susskind, 1984). Many of these people make decisions about whether something is good and safe based not on technical information as much as on the perceived trustworthiness of those providing information about it (Ozawa and Susskind, 1984). If they perceive the proponents of the proposed project to be arrogant, condescending, close-minded, unsympathetic, dishonest, distrustful, and/or unfair they will side with the opposition (Alexandria, 2004).
4. *Be fair.* A just and equitable agreement is worked out through direct and honest negotiations with stakeholders.

D. Community Benefit Agreements

It is often advantageous for developers to enter into a separate agreement with the surrounding community that details all areas of concern and the expected responses. These "host community agreements" often specify design and operation requirements, operational restrictions, environmental impact mitigation, and other concerns (USEPA, 2002). They are especially effective when residents are opposed to a project. Community agreements can take the official form of a Community Benefits Agreement (CBA) or can be a more informal Memorandum of Understanding between the developer and the contractor. Community Benefits Agreements are contracts between community groups and a developer, enabling the groups to enforce commitments to provide community benefits in connection with a development project (Gross, 2008). Such benefits can range in scale from the roadside cleanup of litter to improvements of community schools and funding of public road maintenance. A list of common benefits is provided below:

- Preference for local hiring and training programs
- Limitations on waste generation
- Restrictions on vehicle traffic routes
- Environmental remediation
- Funding for infrastructure improvements
- Financial support for community activities

(USEPA, 2002).

However, it is important to note that Community Benefit Agreements can be controversial and are not favored by all parties. In a 2010 report, the New York City Bar wrote, "It is our recommendation that the city announce that it will not consider C.B.A.'s in making its determinations in the land-use process" (New York City Bar 2010). Perhaps the most significant criticism is that it is difficult to ensure that CBAs are truly representative of the entire community's needs and desires. If stakeholder engagement is not extensive, it is quite possible that a CBA can be negotiated by only a handful of community groups while excluding many others (Gross, 2008). Additionally, as CBAs are a rather recent practice, it has yet to be seen whether CBA negotiators will drive appropriate bargains with developers or whether CBAs will interfere with the planning process (New York City Bar, 2008).

V. Cost Benefit Analysis of Community Engagment

Like many aspects of development, following the above community engagement frameworks can be a costly endeavor. The money associated with research, paying staff, holding public meetings, producing informational materials, and hiring an engagement professional can be significant, especially in the early stages of the project. Developers of relatively smaller projects might see such costs as too high, but our research and an interview with Morton Orentlicher, an independent consultant, has shown that spending money and time on community engagement is worth the costs and essential to the success of most projects. As Director of Special Projects for ThermoEnergy Corporation, a developer of sustainable water treatment and clean energy technologies, Morton, an independent waste management and engineering consultant with over a decade of project development experience, has worked throughout the Northeast, collaborating with communities throughout the construction and operation of projects, and has provided valuable first-hand information on the costs and benefits of community engagement.

Community opposition can grind development projects to a halt, costing time, money, and can often prevent construction and operation. Morton Orentlicher made it clear that both city officials and agencies often do not want to contest communities strongly opposed to projects – hurting the chances of completion (Orentlicher, 2012). Clear cooperation and a good host agreement, however, can provide an important partner for developers and ensure the project's completion; a scenario that is mutually beneficial for all parties. According to Darden Copeland, the managing director of the consulting firm Calvert Street Group, "A good host agreement will often be a project´s saving grace. Done right, it can sway undecided residents into supporting a project … offer-

A Developer's Perspective

"If I were building a food waste facility in New York City, I would get involved with community activists in the borough I wanted to place it. Start with them and find out what do they need in order to feel that this is going to be a good thing for the environment and for the community. Then, through them, reach out to the local groups and have meetings in the schools and the churches. I believe one can do this and be patient. [For developers] with the funds, there is enough money to be made here that they can wait a year. [It is important to] conduct this community engagement before even going through the permit stage." – Morton Orentlicher, Independent Consultant ing nothing, or the legal minimum, is a recipe for disaster "(Copeland, 2012).

Invest Early

Developers that invest time and money early, often benefit the most in the long-term. Once a community unites against a project and forms a strong opposition to a proposed project, it is very difficult and expensive for developers to counteract, regardless of how willing they are to renegotiate (Fox, 2010). Early and aggressive outreach to community members, and stakeholders especially likely to oppose the project, will not only keep residents informed and give them agency to respond, but will provide an opportunity for developers to ease concerns before they become detrimental to the project. Early action can also prevent wasted efforts on siting or expanding a facility in communities that might initially be entirely against development. For example, a construction and demolition debris site in East Brooklyn wanted to replace their current incinerators with fluidized bed combustion – a cleaner burning technology (Orentlicher, 2012). Despite the jobs and environmental benefits this would have had in the community, local church groups – who were the dominant voice in the community – fought any expansion of the facility (Orentlicher, 2012). They wanted a residential neighborhood and would not budge on any expansion proposals regardless of the declared advantages. In this case, early recognition of this barrier would have saved valuable time and money (Orentlicher, 2012). This example is especially relevant to the development of an anaerobic digestion facility on a current waste management site. Without a community outreach strategy, and regardless of the impacts, (good or bad), communities are often opposed to expansion of any kind.

Specific Benefits are More Tangible

Specific benefits offered to the community, though potentially costly, can be good for both stakeholders and developers. By providing financial incentives to a variety of different groups – the education system, parks and recreation, the police department – developers can make a significant impact, while gaining the support from stakeholders (Copeland, 2012). Rather than one large donation to the community in general, targeted benefits can garner more enthusiastic support. Specific allocation might also make the benefits more tangible for community members (Copeland, 2012). Stakeholders can point to something like low-income housing, jobs, or road improvements and know that it was gained through collaboration with developers. Specific benefits give the community something to say 'yes' to, rather than simply saying 'no' to the project.

Clear, Honest Communication

Investing in open, honest dialogue with the community often establishes trust, which is also advantageous to both stakeholders and developers. It is better for the community to bring problems and concerns directly to the developer, rather than publicly protest and cause difficulties finalizing the project (Fox, 2010). If residents are not comfortable or encouraged to approach developers first, insidious rumors, which could be avoided through open dialogue, can start quickly. One example highlighted by Morton Orentlicher was the development of a wastewater treatment plant in the Bronx. The developer, though factually honest with the community, was initially misleading in various impacts of the project.

When the community discovered what the actual consequences would be, they formed a strong and united opposition group that hired outside consultants to assess the developer's methods, leading to the project's relocation. According to Orentlicher, there was a "real insensitivity of the level of impact on the community," which led to a waste of time, money, and effort (Orentlicher, 2012).

Establish Trust

Though it is time consuming and possibly costly, establishing community trust makes good business sense from a project-completion standpoint. An effective engagement approach can often help push through development. ThermoEnergy Corporation, a developer of sustainable water treatment and clean energy technologies, won a bid from NYC to implement an ammonia recovery system at the 26th Ward wastewater treatment plant in Jamaica Bay, Queens. According to Morton Orentlicher, a significant reason for ThermoEnergy's success was that the company reached out to Jamaica Bay community groups, prior to even getting the job, and informed them about the ecological impacts of the new technology. As a result, these residents brought up this option to the city and supported ThermoEnergy in its bid (Orentlicher, 2012).

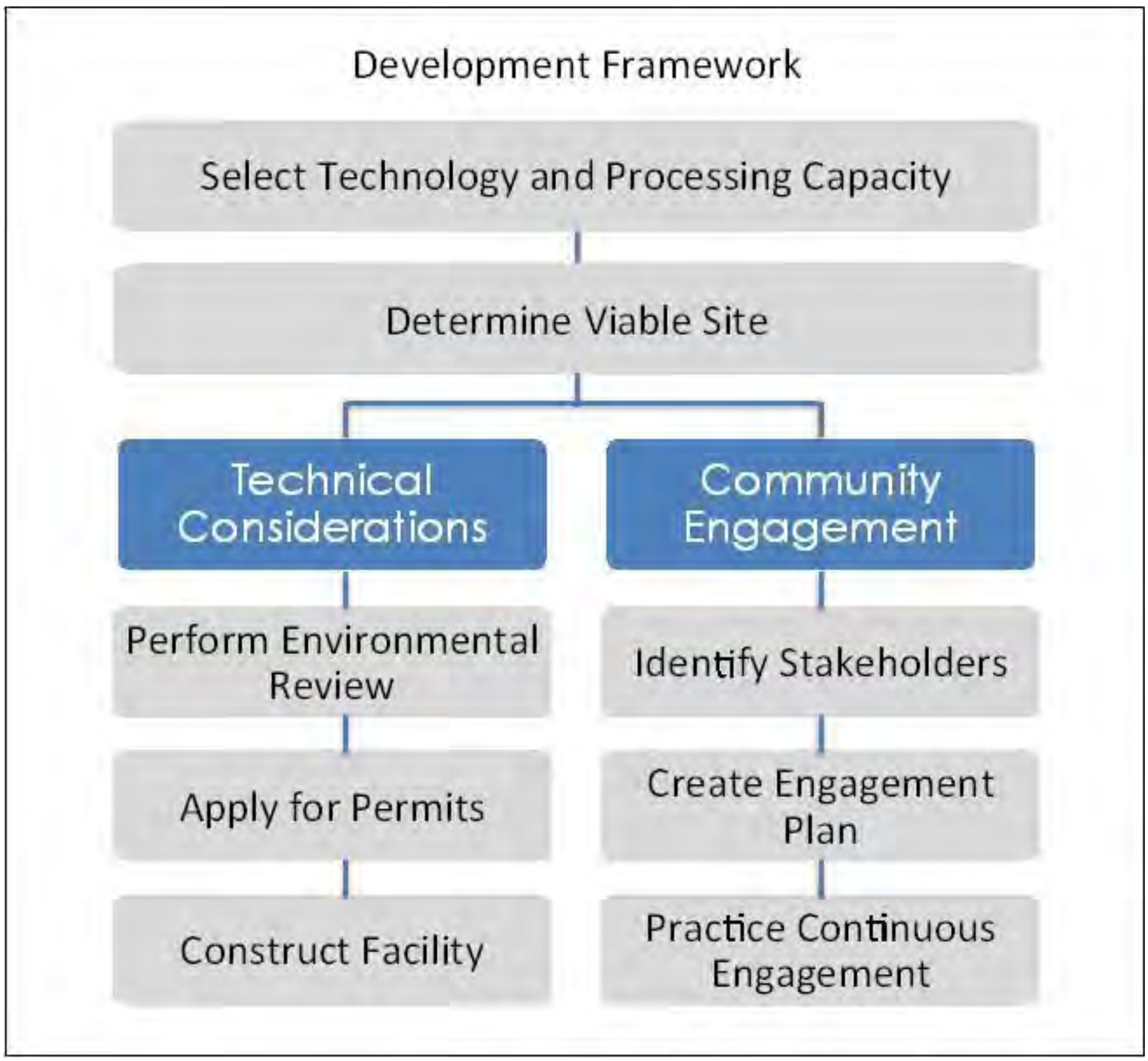
As this case and others above show, communities can either be a powerful ally or a significant barrier towards completing a project. Money spent on community engagement should be seen by developers as part of the financial investment in a project. It is just as important a consideration as fees for lawyers and architects during the period prior to construction (Orentlicher, 2012). The benefits of effective community engagement usually outweigh the initial costs and avoid the potentially project-killing consequences of inaction.

Recommendations

Successful facility development requires comprehensive community engagement occurring simultaneously with the environmental review and permitting processes.

Within New York City, facility siting and permitting represent significant challenges, especially considering the incipient legislation governing many viable food-processing technologies. Food waste management facilities are not well-defined within the current regulatory structure and, as such, clarification from several regulatory bodies might be needed. Both the environmental review and permitting process are lengthy, and are best done in conjunction with the community engagement process, as it is community approval that will ultimately determine the speed and likelihood of successful project development. For this reason community engagement efforts should be actualized as early as possible within the development process; preferably as soon as a processing technology and capacity, as well as a viable site, have been determined.

Figure 10: Our Development Framework



Technology

Selecting a technology is paramount in the food waste facility development process. The environmental review, permitting, and community engagement processes are all determined by the specific technology proposed by the developer. Aerobic digestion, thermal processing and anaerobic digestion were analyzed for their suitability for development in NYC; we found anaerobic digestion to be the most appropriate technology for development in NYC, matching CoRR's findings. Anaerobic digestion has the most appropriate combination of scalability, cost, and palatability to communities among the aforementioned technologies. The City of New York also conducted a three-phase study beginning in 2004, evaluating and identifying suitable new and emerging waste conversion technologies for the city and potential locations for siting these technologies. The study determined that anaerobic digestion was well suited for development in NYC as well.

To further assuage community and environmental concerns, existing air pollution control systems ought to be used to mitigate the air pollution problems posed by the combustion of biogas produced by an anaerobic digester. Pre- and post-combustion technologies will likely both be necessary, as they focus on two different sets of pollutants. From a cursory review of currently used pollution control technologies, we have come to up with the following recommendations. We recommend biofilters and biotrickling filters, the most cost-efficient and environmentally sound methods of pre-combustion purification, be used to purify the biogas prior to combustion; to remove contaminants such as hydrogen sulfide, which is largely responsible for noxious odors. Post-combustion air pollution can most efficiently be addressed with NO_xTech, a process which can remove nitrogen oxides, volatile organic compounds and carbon monoxide from the air stream. Implementing these pollution control technologies will be essential to the community engagement process, and will aid the developer in soothing the potential community concerns regarding air emissions. It should be noted that other options may be available, and developers should review all choices independently before selecting any one technology.

Siting and Zoning

NYC does not have clear guidelines on how an anaerobic digestion facility would be categorized, however we assume that AD facilities would be defined as composting facilities under the solid waste management facility rubric. As there are no clear definitions for anaerobic digestion itself, we recommend that the developer request clarification on the current regulations or request new regulations.

Based on our current understanding of NYC regulations and to expedite the development of the facility, we recommend that anaerobic digesters be sited in an existing M3 zone. The M3 zone is the manufacturing zone, which permits the most heavily-industrial activities. This would obviate the need for a potentially lengthy ULURP process, a process which is necessary for obtaining zoning changes or exemptions.

Environmental Review and Permitting

To minimize costs and expedite the development process it is recommended that for the environmental review process developers skip straight to the EIS, and also submit permitting requests during the environmental review process. In addition to the required discretionary permits, developers must comply with Commissioner Policy – 29, which requires community engagement work be completed in designated environmental justice (EJ) regions. While not all potential sites will fall under the category of EJ regions, community engagement all areas is still highly encouraged, as ultimately the willingness of the government agency to grant successful permit applications will rely on community support.

Community Engagement

Successful community engagement plans, particularly those that identify relevant stakeholders, must be ongoing throughout the lifetime of the facility. Community engagement must also be informative, provide clear and detailed information to the community, and be placed in easily accessible locations to ensure widespread distribution. Moreover, they should be responsive, listening to and incorporating community stakeholders' needs, likely through public meetings. Finally, they should be collaborative, incorporating stakeholders within the decision-making process, likely through the creation of a special committee. Most important are these collaborative efforts, which are not mandated by current environmental justice legislation, but which have a proven record of enhancing community acceptance for proposed projects. With this emphasis on the collaborative method it is doubly essential to begin community engagement early in the project planning process, when development plans are most flexible. The creation of a stakeholder committee early on in the community engagement process can also assist developers with the mandated informative and responsive aspects of their plan, and prevents communities from drawing misinformed conclusions about the nature and impact of the project. While community engagement is a lengthy and sometimes costly affair, establishing community trust can be a vital ally to help push through development.

Conclusions

Although the process of developing food waste management facilities within New York City remains in need of further legislative clarification, food waste management represents a valuable opportunity for the City to increase its sustainability efforts. Both Global Green and our consulting group believe that this is an effort which cannot and should not be overlooked. By following the development framework presented within this report, developers should be able to expedite their siting process while maintaining compliance with both the City government and the community at-large, resulting in lower overall costs and a more cooperative process.

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Endnotes

[1]Two different pilot studies in Brooklyn in the 1990's, DSNY determined that the public concerns over odor and vermin made residents unwilling to participate in curbside separation of food waste (DSNY, 2001). Additionally, the costs associated with transporting the waste were deemed to be onerous. The increase in tonnage reduction from food waste did not justify the addition of another inefficient truck route and the environmental and financial costs that would entail (DSNY, 2001). The challenges in residential food waste collection led the City to conduct a pilot study on Staten Island to determine the feasibility of institutional food waste collection. At the end of the trial, DSNY found there would be many problems with establishing a uniform method of collection (DSNY, 2001). Because many institutions do not have room for a full-scale service dumpster for food waste, smaller dumpsters and retrofitted trucks would be required to streamline collection – an investment deemed to be substantial (DSNY, 2001).

[2] In addition to the removal of H_2S, the removal of siloxanes from raw biogas stream is also a key part of the biogas purification discussion. However, biogas cleaning technologies pertaining to siloxanes removal, such as refrigeration, are omitted here as siloxanes are not dominantly present in the food waste stream. While siloxanes are used as an oil substitute in the food industry to create low-calorie alternative food products such as potato chips, salad dressings, and mayonnaise, quantity of siloxanes found in food waste stream is much smaller than that found in the industrial waste stream (Jankowski, n.d.). Siloxanes are widely employed by industry; they can be found in shampoos, pressurized cans, detergents, cosmetics, pharmaceuticals, and textiles of paper coatings (Abatzoglou and Biovin, 2009). Due to their employment, siloxanes are often found in industrial and landfill gas streams as well as waste sludge (Abatzoglou and Biovin, 2009). Biogas purification technologies used to remove siloxanes are therefore not pertinent to anaerobic digesters that process food waste exclusively.

[3] New York City's 59 community districts, established by local law in 1975, illustrate the remarkable diversity of the city's land uses and population. They range in size from less than 900 acres to almost 15,000 acres, and in population from fewer than 35,000 residents to more than 200,000. (http://www.nyc.gov/html/dcp/html/lucds/cdstart.shtml)

[4] Appendix 2

[5] http://www.dec.ny.gov/regs/4144.html

[6] Three categories of burning rate; Intense burning – materials which with low ignition temperature, high burning rate and large heat evolution, burn with high intensity, Moderate burning – materials which in themselves burn moderately and may contain small quantities of a higher grade of combustibility. Slow burning – materials which will not ignite or actively support combustion during an exposure for five minutes to a temperature of 1,200 degrees F.

[7] Temperature at which a liquid sample produces sufficient vapor to flash, but not ignite, when in contact with a flame in a Tagliabue open cup tester.

[8] Sometimes all three overlap and coordinate simultaneously

[9] Ministerial actions, such as the issuance of a building permit, are not subject to environmental review

[10] Sometimes all three overlap and coordinate simultaneously

[11] Without a test pilot in NYC it is impossible to provide a comprehensive list of specific permits that will apply. Table 4 is intended to provide a general overview of the permits that are expected to be needed for an AD facility

APPENDIX

Appendix 1: Pollution Control Technologies

Physiochemical Processes

Chemical Absorption in Aqueous Solution

The process of removing H_2S through chemical absorption in aqueous solution involves the conversion of H_2S into low solubility metallic sulfides or elemental sulfur (Abatzoglou and Biovin, 2009). The most commonly used aqueous solution for selective absorption of H_2S is the application of amines (Fortuny et al., 2007).

While this physiochemical process has been extensively and successfully applied, the main drawback of this procedure is the high energy and operation costs; specifically, the cost of absorbent solution can be significant (Fortuny et al., 2007).

Chemical Adsorption on Solid Adsorbents

Contrary to the chemical absorption of H_2S in aqueous solutions, chemical adsorption on solid adsorbents is a "dry" process that removes H_2S from a gas stream without requiring the conversion of H_2S gas into a liquid form.

The removal of H_2S via this method is done by making a continuous gas stream flow either upward or downward through a fixed bed of adsorbents, such as iron sponge made of iron oxide adsorbent, until the solid adsorbent becomes saturated (Abatzoglou and Biovin, 2009). Besides iron oxides, activated carbons are another commonly used adsorbent used to remove H_2S, and is most often used for the removal of volatile sulfur compounds (Smet et al., 1998).

The disadvantages associated with chemical adsorption are two-fold. First, as the process involves a continuous gas flow and there is only one fixed bed of adsorbent, the process is not suitable for large-scale desulfurization of a gas stream, which would require frequent stoppages in the process to change the adsorbent bed. Moreover, the solid adsorbent cannot be regenerated and its useful lifespan is relatively short; this increases the costs of deploying this type of technology.

Scrubbing

Solvent-based gas scrubbing technologies have been applied for removing H_2S from gaseous streams in large-scale industrial operations; however, applications of such technologies in biogas are still untested (Abatzoglou and Biovin, 2009). In a solvent-based gas scrubber, polluted air stream is being filtered via contact with the scrubbing solutions.

Scrubbing is considered unsuitable for biogas application for a few reasons. First, it is impossible to remove all contaminants in one stage; S-containing compounds (H_2S, mercaptans) require alkaline scrubbing and N-containing compounds (NH_3) require acidic conditions, and building in two scrubbers can be costly. Second, alkaline scrubbing retains CO_2, which increases the consumption of alkaline chemical and commensurate costs. Lastly, as the gas-liquid transfer rate in this process is slow, scrubbing devices must have a very large gas-liquid contact surface area and long residence times. This necessitates large volumes of solvent and high capital costs (Abatzoglou and Biovin, 2009).

Biological Processes

Conventional Biofilter

A conventional biofilter is a fixed-film or packed bed bioreactor in which a natural filter bed, composed of natural materials like woods, treats pollutants. Polluted air is fed in either a downflow or an upflow through the reactor and the pollutants in the airstream are biodegraded by the biocatalyst present in the packed bed. A liquid phase, composed of water and nutrients, is periodically added to the airstream that goes through the filter beds (Kennes et al. 2009). While natural filter beds are naturally populated with microorganisms and nutrients, they suffer from gradual degradation and compaction over time. More inert packing materials have thus recently been utilized for filter beds (Kennes et al., 2009).

As there is no continuous feed of a liquid phase in conventional biofilters, it is especially suitable for the treatment of hydrophobic and water insoluble compounds. However, the lack of a continuous feed of liquid phase also makes conventional biofilters not the best choice for treating certain pollutants that are more, or highly, water soluble, such as chlorinated compounds.

Biotrickling Filter

Biotrickling filters have a similar configuration to that of the conventional biofilter. One major difference between the two is the continuous feed of a liquid trickling phase and the use of inert packing materials in all cases. Similar to the configuration of conventional biofiters, polluted air is fed through the trickling biofilter where a nutrient solution is trickled through; the pollutants in the gas stream are then treated by microorganisms in the inert packing materials. The presence of a mobile liquid phase in biotrickling filters allows for much easier pH and temperature control and removal of accumulated metabolites, if any (Kennes et al., 2009). Nevertheless, the continuous feed of nutrient trickling solution will lead to biomass growth on the filter bed, which can lead to clogging problems and eventually reactor failure (Kennes et al., 2009). This also signifies a higher O&M costs for biotrickilng filters as the filter beds would need to be replaced more often than conventional biofilters.

Bioscrubber

In a bioscrubber system, polluted air is first fed through an absorption tower (scrubber) to transfer the contaminated air from gas to liquid state. Clean air is then released to the atmosphere from the scrubber, while the polluted water is fed to a bioreactor, where microorganisms biodegrade the pollutants in the aqueous phase. As with biotrickling filters, the presence of a mobile liquid phase in bioscrubbers allows for easy control of important microorganism parameters like pH (Kennes et al., 2009).

Compared with biofilters and biotrickling filters, bioscrubbers can be operated at higher gas loads, up to 3000 – 4000 $m^3\ m^{-2}\ h^{-1}$. Gas loads normally do not exceed 500 $m^3\ m^{-2}\ h^{-1}$ for biofilters. However, much less research has been undertaken on bioscrubbers than on conventional and trickling biofilters, and consequently there are many fewer full-scale bioscrubbers in operation than packed bed biofilters (Kennes et al., 2009).

In addition to the commonly deployed conventional bioreactors, trickling biofilters, and bioscrubbers, other biological processes have been developed and examined, such as membrane bioreactors, two-liquid phase bioreactors, and hybrid and multi-stage systems. A quick description of these various processes follows:

Gas diffusion into suspended-growth bioreactors

Unlike bioscrubber system, gas diffusion into suspended-growth bioreactor allows polluted air to be fed directly into a stirred tank bioreactor, and thus two separate processes are not required (Kennes et al., 2009).

Membrane bioreactors

Membrane bioreactors consist of a gas phase and an aqueous phase; a membrane separates the two phases. Polluted air is first fed through the gas phase, where gas molecules absorb or dissolve into the membrane surface; they then diffuse through the membrane and are degraded by biocatalysts attached to the biofilm side of the membrane. The biodegrading activity of that biofilm creates a driving force for the continuous transfer of the gas molecules through the membrane. The performance of membrane reactors is shown to be similar to that of other more conventional bioreactors (Kennes et al., 2009).

While the full-scale application of this technology is relatively well established in wastewater treatment, no full-scale results have yet been reported for waste gas treatment. Furthermore, membranes are of relatively high costs compared with conventional bioprocesses. Membranes can also yield lower permeability over time (Kennes et al., 2009).

Rotating biodiscs and biodrums

Rotating biodiscs and biodrums are composed of an airtight vessel containing bundles of discs or drums. About 40% of the discs or drums are submerged in a nutritive liquid solution, while the remaining disc/drum surface is in contact with the polluted air stream flowing through the system while rotating. A biofilm progressively develops on the surface of the rotating discs or drums, alternating its exposure to soluble nutrients in the aqueous phase, and to air and volatile pollutants present in the gas phase (Kennes et al., 2009).

An advantage of this system is the absence of clogging, which is typical of packed bed biofilters. In terms of performance, laboratory-scale studies undertaken with dichloromethane-polluted air showed that the rotating biodiscs and biodrums' performance was similar, or somewhat lower, than with biotrickling filters. Rotating drum biofilter in particular has been shown to be suitable for the anaerobic removal of pollutants such as nitric oxide through denitrification (Kennes et al., 2009).

Two-liquid phase bioreactors

In addition to using water, two-liquid phase bioreactors also deploy a second, water-immiscible, liquid phase. The addition of an organic liquid phase is primarily useful for the removal of quasi-water-soluble pollutants; the removal efficiency of less hydrophobic pollutants can thus be increased in such systems (Kennes et al., 2009).

This type of system is potentially highly favorable for the removal of high concentrations and high loads (including shock loads) of particularly un-water-soluble compounds. However, an organic solvent phase is expected to increase the overall treatment costs. Silicone oil is the most popular and most commonly used organic liquid phase (Kennes et al., 2009).

Hybrid and multi-stage systems

Hybrid and multi-stage systems consist of using two bioreactors in series. A common example is the use of two biofilters for the removal of sulfur compounds such as H_2S mixed with VOCs. A pilot study done at a wastewater treatment facility plant showed that combining a first stage low-pH inorganic biofilter with a second stage neutral-pH organic biofilter led to the best results (Kennes et al., 2009).

Post Combustion Pollution Control

Catalytic Oxidation/Selective Catalytic Reduction

A proven and effective means for CO-, VOCs-, and NO_x-control among natural gas fueled lean-burn engines is catalytic oxidation with selective catalytic reduction (SCR). Significantly, if raw biogas is cleaned sufficiently and effectively, there is no danger of fouling any post-combustion catalyst by siloxane deposition. Although siloxane deposition is not commonly associated with food waste, trace amounts can be found if oil containing siloxane residue is present in the food stock. Catalytic oxidation removes CO and VOCs upon their contact with the catalyst. Oxidation catalysts contain precious metals, which react incoming CO and VOC with oxygen to produce CO_2 and water vapor. Reductions greater than 90% in CO and VOC emissions are typical with this technology. SCR can be used with lean-burn engines since the higher oxygen concentrations in the exhaust preclude the use of less costly nonselective catalytic reduction. SCR requires the injection of urea to react with the NO_x in the engine's flue gas, and is very effective in its removal. The SCR catalyst promotes the reaction of ammonia with NO_x and oxygen, with water vapor and nitrogen gas being the end products (New York State Energy Research and Development Authority, 2008).

A consideration when applying SCR technology is the potential for ammonia slip, or the passage of ammonia through the SCR unreacted, when injecting urea into any exhaust gas stream. Ammonia is a toxic compound, and careful control must be taken in order to prevent excess amounts from escaping out of the stack. This can be regulated through monitoring the urea injection rate. An important factor when adjusting urea injection rates is ensuring that sufficient amounts of urea are injected in response to the engine's load demand and/or NO_x level in real time or as close to real time as possible. This is to prevent too much ammonia from slipping out of the stack while also simultaneously preventing too little urea from entering the exhaust stream that would result in an increase in NO_x out of the stack (New York State Energy Research and Development Authority, 2008).

NO_xTech

NO_xTech is another post combustion control technology that is non-catalytic, does not require gas cleanup, and is capable of achieving multi-pollutant control of NO_x, VOC, and CO. Engine exhaust gases enter the unit, whereupon the temperature is raised by a heat exchanger. The gases then enter a reaction chamber where a small amount of the engine's fuel is added to further raise the gas temperature to 1400-1500F. At this temperature in the reaction chamber, NO_x reduction can be achieved by using urea injection, while CO and VOC are simultaneously incinerated. The system is designed to handle biogas of lower British Thermal Unit (BTU) content, compared to higher BTU content natural gas (South Coast Air Quality Management District, 2012).

A NO_xTech system can be a less costly installation than traditional catalytic oxidation/SCR technology, due in large part to the anticipated lower operations and maintenance (O&M) costs. Intermittent sorbent and catalyst replacements are a significant portion of the O&M costs incurred with the operation of a catalytic oxidation/SCR system. A NO_xTech system eliminates the need for sorbents and catalysts. Urea injection, however, is still a required component for a NO_xTech system as well as an SCR system (South Coast Air Quality Management District, 2012).

APPENDIX 2: SWMP LONG-TERM EXPORT FACILITIES AND WASTESHEDS

Excerpt from the Comprehensive Solid Waste Management Plan showing the City's plan for a more environmentally sustainable and socially equitable waste strategy (DSNY 2006).

Appendix 3: Performance Standards

Noise

Table 6: Maximum allowable noise levels in M2 and M3 zones (Zoning Resolution Article IV, Chapter 2, §42-21)

Octave Band (Hz)	District	
	M2 (dB)	M3 (dB)
20 to 75	79	80
75 to 150	75	75
150 to 300	68	70
300 to 600	62	64
600 to 1200	56	58
1200 to 2400	51	53
2400 to 4800	47	49
Above 4800	44	46

Table 7: Decibel comparison chart to everyday activities (New York City Department of Environmental Protection (a), 2011)

Action	Decibel Level
Whisper	30
Normal Conversation/Laughter	50-65
Vacuum Cleaner at 10 feet	70
Washing Machine/Dishwasher	78
Midtown Manhattan Traffic Noise	70-85
Motorcycle	88
Lawnmower	85-90
Train	100
Jackhammer/Power Saw	110
Thunderclap	120
Stereo/Boom Box	110-120
Nearby Jet Takeoff	130

Smoke and Other Particulate Matter

	M1	M2	M3
Maximum permitted emission of smoke	10 smoke units per hour	20 smoke units per hour	30 smoke units per hour
Emission of dust related to combustion for indirect heating from any source A – plants producing heat input of 10M BTU or less per hour B – plants producing heat input of 10,000M BTU or more per hour	A - 0.5 pounds B - 0.15 pounds	A - 0.6 pounds B - 0.16 pounds	A - 0.7 pounds B - 0.18 pounds
Emission of dust or other particulate matter unrelated to combustion for indirect heating or incineration	0.5 pounds per hour for 100 pounds of process weight 50 pounds per hour for 100,000 pounds of process weight		
Maximum dust or other particulate matter from all sources	33 pounds per hour	250 pounds per hour	NA

Fire and Explosive Hazards

Classification of materials

1. Class I includes slow burning to moderate burning materials; includes all liquids with an open cup flash point of 182 degrees F or more.
2. Class II includes free burning to intense burning materials; includes all liquids with an open cup flash point between 100 and 182 degrees F.
3. Class III includes materials which produce flammable or explosive vapors or gases under ordinary weather temperature; includes all liquids with an open cup flash point of less than 100 degrees F.
4. Class IV includes materials which decompose by detonation; includes all primary explosives, all high explosives, propellants and their components, pyrotechnics and fireworks, blasting explosives, unstable organic compounds and others.

Regulations for Class I materials or products

Class I materials or products may be stored, manufactured, or utilized without limitation in manufacturing processes or other production in all manufacturing district.

Regulations for Class II materials or products

Class II materials or products may be stored, manufactured or utilized in manufacturing processes or other production in accordance with the regulations outlined below.

M1	• Manufacturing and utilization must be in structures which are completely enclosed by incombustible exterior walls, protected throughout by automatic fire extinguishing systems compliant with the Administrative Code, and at least 40 feet from any lot lines. • Storage limited to 100,000 gallons
M2	• Manufacturing and utilization without limitation • Storage limited to 200,000 gallons; not applicable to underground tanks or finished products in original sealed containers • If within 100 feet of M1, Residential or Commercial, M1 regulations apply
M3	• Storage, manufacturing, or utilization without limitation • If within 100 feet of M1, Residential or Commercial, M1 regulations apply

Regulations for Class III materials or products

Class III materials or products may be stored, manufactured or utilized in manufacturing processes or other production in accordance with the regulations outlined below.

M1	• Manufacturing not permitted under any event • Storage or utilization only within structures that are completely enclosed by incombustible exterior walls, protected throughout by automatic fire extinguishing systems compliant with the Administrative Code, at least 40 feet from any lot lines, and final manufactured products with a rating of Class I • Storage limited to 50,000 gallons
M2	• Manufacturing not permitted under any event • Storage or utilization such that the final manufactured product has a rating of Class II • Storage limited to 100,000 gallons; not applicable to underground tanks or finished products in original sealed containers • If within 100 feet of M1, Residential, Commercial, M1 regulations apply
M3	• Storage, manufacturing, or utilization without limitation • If within 400 feet of M1, Residential or Commercial, M1 regulations apply • If within 300 feet of M2, storage limited to 200,000 gallons; not applicable to underground tanks or finished products in original sealed containers.

Regulations for Class IV materials or products

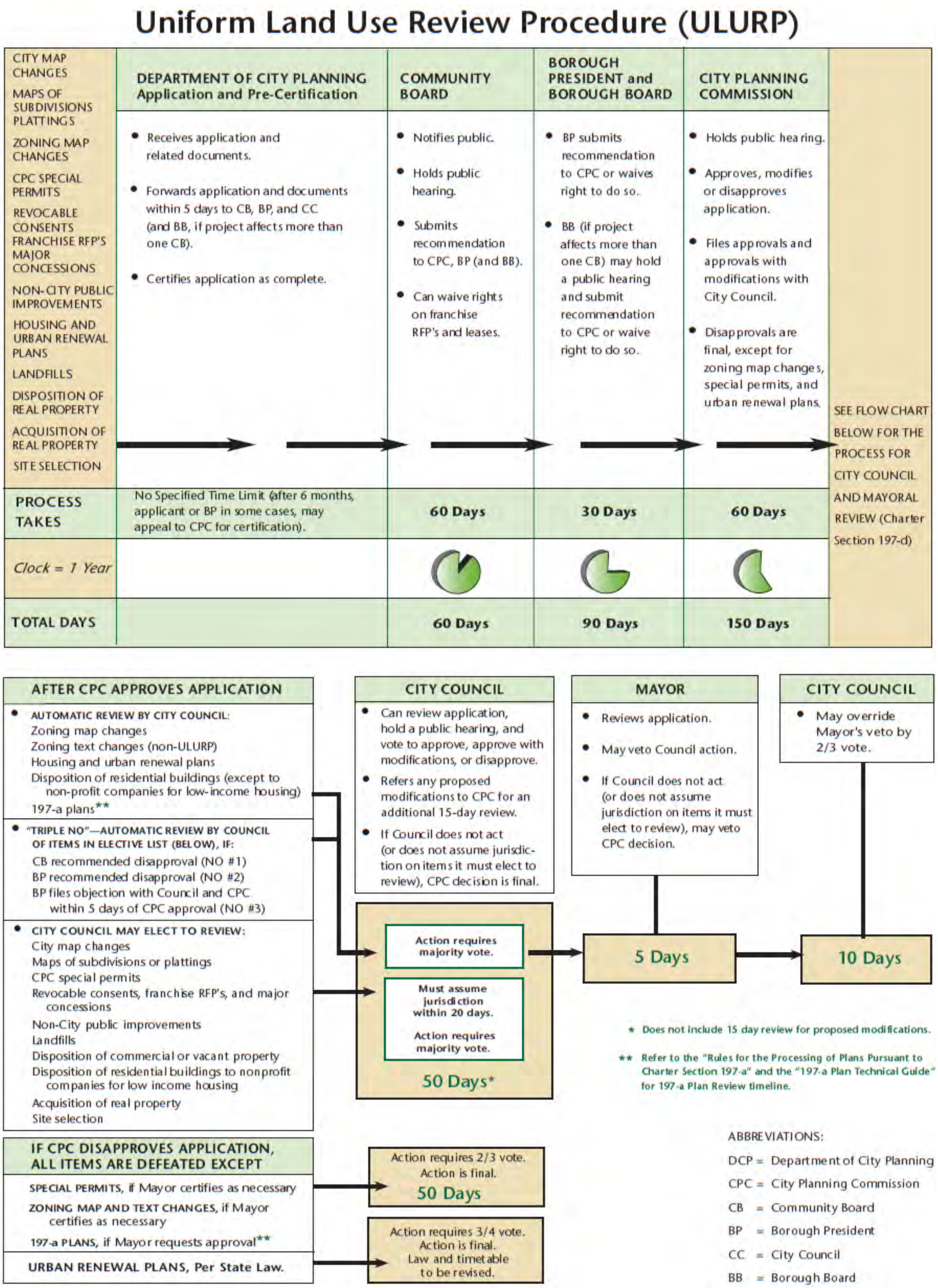
Class IV materials or products shall not be manufactured in any Manufacturing District and can be utilized only when authorized by a special permit granted by the Board of Standards and Appeals in accordance with the provisions of Article VII, Chapter 3. Storage it not permitted in any district except as authorized by special permit.

Regulations applying to oxygen manufacture, storage, or utilization

Oxygen, gaseous or liquid, shall not be manufactured except when authorized by a special permit granted by the Board of Standards and Appeals in accordance with the provisions of Article VII, Chapter 3. Storage and utilization is permitted with the Administrative Code such that total quantity at standard temperature and pressure does not exceed 150,000 cubic feet in M1 and 500,000 cubic feet in M2. Storage and utilization is unlimited in M3.

Appendix 4: ULURP Timeline

Figure 11: ULURP Timeline, taken from http://www.nyc.gov/html/dcp/pdf/luproc/lur.pdf



Appendix 5: Regulations Referenced

New York City Regulations

6 NYCRR Part 200: Air Pollution Proposed, Emergency, and Recently Adopted Regulations; General Provision, Express Terms

6 NYCRR §360-1: Chapter IV – Quality Services; Subchapter B: Solid Wastes; General Provisions

6 NYCRR IV § 360-5: Chapter IV – Quality Services; Subchapter B: Solid Wastes; Composting Facilities

6 NYCRR Part 375: Chapter IV – Quality Services; Subchapter B: Solid Wastes; Environmental Remediation Programs

6 NYCRR Part 487: Environmental Justice Proposed Regulation

6 NYCRR Part 601: Water Supply Applications

6 NYCRR Part 703: Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations

19 NYCRR Part 600: Chapter XIII – Waterfont Revitalization of Coastal Areas and Inland Waterways; Policies and Procedures (begins on page 1)

19 NYCRR Part 603: Chapter XIII – Waterfont Revitalization of Coastal Areas and Inland Waterways; Harbor Management (begins on page 32)

RCNY Title 3 §202-01: Rules of the Fire Department of the City of New York; Definitions (begins on page 77)

RCNY Title 15 § 28-104: Chapter 28 – Citywide Construction Noise Mitigation; Alternative Noise Mitigation Plan (begins on page 24)

Alternative Noise Mitigation Plan Sample Form

RCNY Title 16 §4-12: Department of Sanitation; Compliance with State and Local Law

RCNY Title 16 §4-13: Department of Sanitation; Sites and Plans

RCNY Title 16 §4-14: Department of Sanitation; Permits

Construction Code §28-408.1: Administrative Code, Article 408 Master Plumber License Required

Construction Code §28-410.1: Administrative Code, Article 410; Master Fire Suppression Piping Contractor License Required

SWMP Guidance Manual: Department of Sanitation

New York City Water and Sewer Forms

Zoning Resolution 2011, Article IV, Chapter 2 – Use Regulations

The Uniforms Land Use Review Procedure (ULURP) Rules: Department of City Planning

New York State Regulations

DMM-SW-09-01: Solid Waste Management Facility Permitting Policy

GP-0-10-001: SPDES General Permit for Stormwater Discharges from Construction

GP-0-11-009: Interim SPDES Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activity

Model Sewer Use Law

ECL Article 15 Title 33: Water Withdrawal Reporting

Environmental Conservation Law